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

–: પરિપત્ર :–

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓને તથા વિભાગીય વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રકચર બી.એસસી. બાયોટેકનોલોજી પ્રોગ્રામના સેમેસ્ટર–૧ અને ૨ ના Major, Minor, MDC, SEC ના અભ્યાસક્રમ અંગે બી.એસસી. એન્ડ એમ.એસસી. બાયોટેકનોલોજી વિષયની નિયૂકત (એડહોક) સમિતિની તા.૦૮/૧૨/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરી અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલ તા.૦૬/૦૧/૨૦૨૪ની સભાનાં ઠરાવ ક્રમાંકઃ૨૬ થી સ્વીકારી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

બી.એસસી.એન્ડ એમ.એસસી. બાયોટેકનોલોજી વિષયની નિયૂકત (એડહોક) સમિતિની તા.૦૮/૧૨/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રકચર બી.એસસી. બાયોટેકનોલોજી પ્રોગ્રામના સેમેસ્ટર–૧ અને ૨ ના Major, Minor, MDC, SEC ના અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખા ને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલ તા.૦૬/૦૧/૨૦૨૪ની સભાનાં ઠરાવ ક્રમાંકઃ ૨૬

:: આથી ઠરાવવામાં આવે છે કે, NEP-2020 અંતર્ગત નવા ક્રેડિટ સ્ટ્રકચર બી.એસસી. બાયોટેકનોલોજી પ્રોગ્રામના સેમેસ્ટર–૧ અને ૨ ના Major, Minor, MDC, SEC ના અભ્યાસક્રમ અંગે બી.એસસી. એન્ડ એમ.એસસી. બાયોટેકનોલોજી વિષયની નિયૂકત (એડહોક) સમિતિની તા.૦૮/૧૨/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ વિજ્ઞાન વિદ્યાશાખાની મંજૂરી અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૬૬૯/૨૦૨૪
તા.૦૮–૦૧–૨૦૨૪

કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા વિભાગીય વડાશ્રી.
..... આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program

In

Biotechnology

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

Program Outcome (PO):

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

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

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology-Major

Teaching & Evaluation Scheme

Semester-I & II

[Academic Year of Implementation 2023-2024]

Semester-I

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-101	Introduction to Biotechnology	3	2	35	35	70	3
BT-MJ-102	Cell Biology	3	2	35	35	70	3
BTP-MJ-1	Practical	4	4	30	30	60	2
			Total	**100**	**100**	**200**	**8**

Semester-II

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-201	Biochemistry of Water	3	2	35	35	70	3
BT-MJ-202	Biomolecules	3	2	35	35	70	3
BTP-MJ-2	Practical	4	4	30	30	60	2
			Total	**100**	**100**	**200**	**8**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

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

Semester-I: Course: BT-MJ-101: Introduction to Biotechnology

Course Code	BT-MJ-101
Course Title	**Introduction to Biotechnology**
Course Level	100-199
Credit	3
Total engagement	3 Credits x 15 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	With the use of cutting-edge biotechnology, mankind are currently able to combat crippling and rare diseases, reduce our impact on the environment, alleviate hunger, use less and cleaner energy, and develop safer, cleaner, and more efficient industrial manufacturing processes.
Course Objective	The goal of the biotechnology curriculum is to provide students with a fundamental understanding of scientific theories of biotechnology, hands-on experiments, techniques, and methods. It also aims to apprise students with recent advancement in the field of Biotechnology.
Course Outcomes	CO1: To understand the basic concepts, history and knowledge about of Biotechnology by learning its global impact on society as well as environment. CO2: Students will learn about the recent advancement and trends in biotechnology sector both public and privet sector, different initiatives to encourage and motivate students to explore diverse avenues such as research funding, start-up endeavour's, skill-oriented training, and employment opportunities. CO3: Acquire knowledge in students of biotechnology enabling them applications in industry and research.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								

Pre-requisite	Biology	
Course Content	**UNIT-1: Basic Concept of Biotechnology:** Introduction, Definition of Biotechnology, History of Biotechnology, Old and New Biotechnology, Biotechnology as interdisciplinary area, Different colors of Biotechnology, Biotechnology: Three component central core, Global impact and current excitement of Biotechnology.	Teaching Hours: 12
	UNIT-2: Biotechnology in State and Nation: Role of GSBTM, STBI and GBRC; Innovation and Entrepreneurship Ecosystem, Incubation centres and	Teaching Hours: 15

	Regulatory bodies; Introduction to DBT, Autonomous institutions of DBT, Public Sector undertaking of DBT, BTIS-NET, Introduction to ABLE.	
	UNIT-3: Applications of Biotechnology Agricultural Biotechnology, Medical Biotechnology, Environmental Biotechnology, Food Biotechnology, Industrial Biotechnology, Genetic Engineering, Economics and Biotechnology: Advent of Econo-Biotechnology.	Teaching Hours: 18
Reference Books	• Sobti, R. C., & Pachouri, S. S. (2008). *Essentials of Biotechnology* (1st ed) Ane Books Pvt. Ltd. • Smith, *J.* E. (2009). *Biotechnology* (5th ed). Cambridge University Press; https://doi.org/10.1017/CBO9780511802751 • Ratledge, *C.* (2006). *Basic biotechnology (2006)* (1st ed), Publisher: Cambridge University Press, ISBN: 9780511802409. https://doi.org/10.1017/CBO978051180240 • Gupta, P. K. (2010). *Elements of biotechnology* (2nd ed). • Singh, B. D. (2010). *Biotechnology* (4th ed), Kalyani Publishers. Dubey, R. C. (2022). *A textbook of Biotechnology, S. Chand* (5th ed).	
e-learning resources	https://dbtindia.gov.in/ https://btm.gujarat.gov.in/ https://gbrc.gujarat.gov.in/ https://stbi.gujarat.gov.in/ https://dbtindia.gov.in/scientific-decision-units/computational-biology/btis-network http://www.btisnet.gov.in/ https://ableindia.in/	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

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

Semester-I: Course: BT-MJ-102: Cell Biology

Course Code	BT-MJ-102
Course Title	**Cell Biology**
Course Level	100-199
Credit	3
Total engagement	3 Credits x 15 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The goal of this course is to introduce students with a very basic knowledge and understanding of the basic unit of life: the cell, its structure, composition and function.
Course Objective	The course will stand on its utility towards learning and implementing the aspects towards basic cell biology.
Course Outcomes	The student at the completion of the course will be able to CO1: Understand the structure and function of eukaryotic and prokaryotic cells. CO2: To be familiar with all the cell organelles. CO3: Students will acquire detailed knowledge of how a cell divides leading to the growth of an organism.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								

Pre-requisite	Biology	
Course Content	**UNIT-1: Cell as a Basic unit of Living Systems:** Discovery of cell, The cell theory, Ultra structure of a eukaryotic (plant and animal cells) and prokaryotic cell, Structural organization and functions of plasma membrane and cell wall of eukaryotes.	Teaching Hours:12
	UNIT-2: Cellular Organelles: Structure and functions of cell organelles– Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Ribosomes, Lysosomes, Peroxisomes, Nucleus (Nuclear envelope with nuclear pore complex, Nucleolus, Nucleoplasm and Chromatin). Vacuole, Cytosol and Cytoskeleton structures (Microtubules, Microfilaments and Intermediate filaments).	Teaching Hours:17

	UNIT-3: Cell Division: Cell cycle- Cell cycle *in vivo*, Control of cell cycle. M Phase: Mitosis and Cytokinesis- Prophase, Pro-metaphase, Metaphase, Anaphase, Telophase. Forces required for mitotic movements, Cytokinesis, Meiosis- The stages of meiosis, Genetic recombination during meiosis. Various cell division mechanism in prokaryotes.	Teaching Hours:16
Reference Books	• Gerald Karp (2014). Cell Biology VII Edition. WILEY. • Lodish *et al* (2008). Molecular Cell Biology. VI Edition. Freeman & Co, USA. • De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia. • Cooper, G.M. and Hausman, R.E. (2007). The Cell: A Molecular Approach. IV Edition. ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.	
e-learning resources	SWAYAM (https://swayam.gov.in/)	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

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

Semester-I: Course: BTP-MJ-1: Practical

Course Code	BTP-MJ-1
Course Title	**Practical**
Course Level	100-199
Credit	2
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per week	4 h X 1 day = 4 h
Minimum weeks per semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	The purpose of this course is to provide participants with a comprehensive understanding of laboratory safety practices, essential laboratory equipment, sterilization techniques, proper handling of laboratory waste, and various staining and counting procedures commonly used in scientific research and analysis.
Course Objective	The objective of this course is to equip participants with the necessary knowledge and skills related to laboratory safety, equipment operation, sterilization techniques, waste management, and staining/counting procedures.
Course Outcomes	By the end of this course, students will have: • Developed a strong understanding of laboratory safety rules and regulations, ensuring their ability to create and maintain a safe working environment. • Acquired knowledge of the principles, working mechanisms, and applications of key laboratory instruments, enabling them to use these instruments effectively in scientific research and analysis. • Gained expertise in the principles, working mechanisms, and uses of sterilizers, allowing them to properly sterilize laboratory equipment and materials. • Mastered the techniques for preparing and sterilizing glassware and culture media, minimizing contamination risks in laboratory experiments. • Gained awareness of proper waste disposal and segregation practices, contributing to environmentally friendly and safe laboratory operations. • Acquired practical skills in DNA staining using Schiff's reagent and *Allium cepa* peel, facilitating genetic analysis. • Developed the ability to study and identify divisional stages in mitosis using onion root tips, enhancing understanding of cellular processes. • Attained knowledge and proficiency in identifying Barr bodies from Buccal smears, aiding in genetic investigations. • Gained practical experience in Geimsa staining for blood cell analysis, enabling them to identify and study various blood cell types.

<table>
<tr><td></td><td>• Acquired the skill to perform R. B. C. counts using a Haemocytometer, facilitating quantitative analysis in hematology.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO 1-10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>1. Understanding laboratory safety and rules.
2. Principle, working and use of: Microscope, Incubator, pH meter & Centrifuge.
3. Principle, working and uses of sterilizer: Hot air oven and Autoclave.
4. Preparation and sterilization of glassware's and Culture media.
5. Laboratory waste and biomedical waste disposal and segregation.
6. DNA staining by Schiff's reagent using peel of Allium cepa.
7. Study of divisional stages in mitosis from onion root tips.
8. Barr body from Buccal smear.
9. Geimsa staining of blood cells.
10. R. B. C count by Haemocytometer.</td></tr>
<tr><td>Reference Books</td><td>• Patel, R. (2019) Experimental Microbiology vol 1 and vol 2, 5th ed. Aditya Publication.
• Nigam, A. and Ayyagari, A. (2007) Lab Manual in Biochemistry, Immunology and Biotechnology, Tata McGraw-Hill Publishing Company, New Delhi.
• Aneja, K. R. (2014) Laboratory Manual of Microbiology and Biotechnology, MedTech, Scientific International Pvt. Ltd., New Delhi.</td></tr>
<tr><td>Teaching Methodology</td><td>Laboratory work, Journal preparation</td></tr>
<tr><td>Evaluation Method</td><td>50% CCE (Continuous and Comprehensive Evaluation)-Formative &
50% SEE (Semester End Evaluation)-Summative</td></tr>
</table>

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

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

Semester-II: Course: BT-MJ-201: Biochemistry of Water

Course Code	BT-MJ-201
Course Title	**Biochemistry of Water**
Course Level	100-199
Credit	3
Total engagement	3 Credits x 15 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	It provides a comprehensive understanding of the fundamental role of water plays in biological systems. It is designed to provide solid foundation for understanding the intricate interplay between water and biological systems.
Course Objective	By exploring the biochemistry of water, students will gain insights into its unique physical and chemical properties, including hydrogen bonding, polarity and its influence on bio-molecular interactions. Understanding these principles is vital for comprehending various biological processes, such as enzyme catalysis, protein folding, and the stability of biomolecules.
Course Outcomes	CO1: Upon completing this unit, student will have a strong understanding of the evolution of life on Earth, the chemical foundations of biochemistry, and the weak interactions in aqueous systems. They will be equipped with the knowledge and analytical skills necessary to study biological systems at the molecular level, interpret biological phenomena, and pursue further studies or careers in life sciences. CO2: By the end of this unit, students should have a solid understanding of the ionization of water, weak acids, and weak bases, as well as the principles and mechanisms behind buffering against pH changes in biological systems. CO3: The topics on water as a reactant and the fitness of the aqueous environment for living organisms aims to provide students with a comprehensive understanding of the role of water in chemical reactions and its significance for sustaining life.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								

Pre-requisite	Chemistry, Biology	
Course Content	**UNIT-1:** Introduction; Landmarks in the evolution of life on Earth; Chemical foundations of Biochemistry; Weak interactions in Aqueous systems.	Teaching Hours: 20

	UNIT-2: Ionization of water, weak acids and weak bases; Buffering against pH changes in biological systems.	Teaching Hours: 15
	UNIT-3: Water as a reactant; The fitness of the Aqueous Environment for Living Organisms.	Teaching Hours: 10
Reference Books	• Nelson, D. L. and Cox, M. M. (2017) Lehninger: Principles of Biochemistry 7th Edition, W. H. Freeman, Macmillan Learning, New York.	
e-learning resources	SWAYAM (https://swayam.gov.in/)	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

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

Semester-II: Course: BT-MJ-202: Biomolecules

Course Code	BT-MJ-202
Course Title	**Biomolecules**
Course Level	100-199
Credit	3
Total engagement	3 Credits x 15 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	To give students basic idea regarding biomolecules
Course Objective	Students will know the basics about Biomolecules
Course Outcomes	CO1: Students will know about hetero-polysaccharides and nucleic acid CO2: Students will aware about basic structure, types and variety of amino acids proteins functions CO3: Students will get the knowledge of different types of lipids with its properties.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								

Pre-requisite	Biology	
Course Content	**UNIT-1: Carbohydrates and Nucleic Acid:** Carbohydrate: Definition and Classification, Polysaccharides and its types, Biologically important glycosides, Carbohydrates as information molecules, Nucleosides and nucleotides, Structure of DNA and RNA (m-RNA, t-RNA, r-RNA, hn-RNA).	Teaching Hours: 15
	UNIT-2: Amino acids and Pròteins: Amino acids and its classification, Non-Standard amino acids, Non-protein amino acids, Classifications of proteins (based on –source, shape, composition and solubility) Properties of proteins, Structure of proteins, Biological roles of proteins.	Teaching Hours: 15
	UNIT-3: Lipids: Lipids: Definition and Classification, Physical properties of Lipids, Biological roles of Lipids.	Teaching Hours: 15
Reference Books	• Cox, D. N. (2017). Lehninger Principles of Biochemistry (7th ed.). New York: Macmillan education. • Jain & Jain (2009). Fundamentals of Biochemistry. New Delhi: S. Chand.	

	• U. Satyanarayana, U. a. (2019). Biochemistry (5th ed.). new delhi: RELX india and Books and Allied Pvt. Ltd.
e-learning resources	SWAYAM (https://swayam.gov.in/)
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program in Biotechnology (B. Sc.)

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

Semester-II: Course: BTP-MJ-2: Practical

Course Code	BTP-MJ-2
Course Title	**Practical**
Course Level	100-199
Credit	2
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per week	4 h X 1 day = 4 h
Minimum weeks per semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	Course aims to provide students with a strong foundation in laboratory techniques and scientific methodology, enabling them to approach scientific investigations with confidence, precision, and a thorough understanding of the principles and techniques involved.
Course Objective	The objective of the course is to provide students with a comprehensive understanding of scientific methodology and laboratory techniques. It aims to develop their skills in experimental design, data collection, analysis, and interpretation. The course focuses on exploring various scientific phenomena, such as surface tension, buffer systems, and qualitative tests for carbohydrates, proteins, and lipids.
Course Outcomes	By the end of this course: • Students will understand the importance of formulating a hypothesis, collecting and analyzing data, and drawing conclusions based on the results obtained. • Participants will be proficient in measuring the surface tension of water and comparing it to solutions with varying concentrations. They will understand how solutes affect surface tension and be able to interpret the results obtained through experimental analysis. • Students will be able to plot a titration curve and determine the pKa value of a weak acid. They will understand the principles behind acid-base titrations and be able to analyze experimental data to obtain accurate pKa values. • Students will understand the concepts of buffering and be able to calculate the buffer capacity based on experimental measurements. • Participants will have a comprehensive understanding of buffer systems commonly found in biological systems. They will be able to identify and analyze the components of buffer systems, as well as their importance in maintaining pH stability in biological processes. • They will be familiar with various chemical reagents used in carbohydrate analysis and understand the principles behind these

<table>
<tr><td></td><td>tests, enabling them to identify the presence of carbohydrates in different samples.
• They will possess the knowledge of specific reagents and techniques used in protein detection, allowing them to identify the presence of proteins in various samples.
• They will understand the chemical reactions involved in lipid detection and be able to interpret the results obtained through these tests, enabling them to identify the presence of lipids in different samples.
• Participants will be capable of determining various parameters such as acid value, iodine number, and saponification number. They will understand the principles behind these measurements and their significance in analyzing the quality and properties of oils and fats.
• Participants will gain proficiency in protein estimation using methods such as Folin-Lowry, Bradford, and Bromo Cresol Green (BCG). They will be able to perform accurate protein estimations, and interpret the results obtained through these techniques.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td><table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO 1-10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>1. Scientific method introduction: Design and conduct a simple experiment to investigate a scientific question, including formulating a hypothesis, data collection and analysis.
2. Measure the surface tension of water and compare it with solutions of different concentrations, investigating the impact of solutes on surface tension.
3. Plot a titration curve and determine the pKa value of the weak acid.
4. Determining capacity of buffer solution.
5. Explore buffer systems commonly found in biological systems.
6. Qualitative test for carbohydrates.
7. Qualitative test for proteins.
8. Qualitative test for lipids.
9. Acid Value/Iodine Number/Saponification Number.
10. Folin-Lowry/Bradford/Bromo Cresol Green (BCG) method for protein estimation.</td></tr>
<tr><td>Reference Books</td><td>• Patel, R. (2019) Experimental Microbiology vol 1 and vol 2, 5th ed. Aditya Publication.
• Kamboj, P. C. (2008) University Practical Chemistry, Vishal Publishing Company, Punjab.
• Aneja, K. R. (2014) Laboratory Manual of Microbiology and Biotechnology, MedTech, Scientific International Pvt. Ltd., New Delhi.</td></tr>
<tr><td>Teaching Methodology</td><td>Laboratory work, Journal preparation</td></tr>
<tr><td>Evaluation Method</td><td>50% CCE (Continuous and Comprehensive Evaluation)-Formative &
50% SEE (Semester End Evaluation)-Summative</td></tr>
</table>

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty): Minor Elective

Teaching & Evaluation Scheme

Semester-I & II

[Academic Year of Implementation 2023-2024]

Semester-I

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-ME-101	Basics of Biochemistry	2	1:30	25	25	50	2
BTP-ME-1a	Practical	4	4:00	25	25	50	2
	Total	6	5:30	**50**	**50**	**100**	**4**
BT-ME-102	Ecological Studies	2	1:30	25	25	50	2
BTP-ME-1b	Practical	4	4:00	25	25	50	2
	Total	6	5:30	**50**	**50**	**100**	**4**

Semester-II

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-ME-201	Water Footprint	2	1:30	25	25	50	2
BTP-ME-2a	Practical	4	4:00	25	25	50	2
	Total	6	5:30	**50**	**50**	**100**	**4**
BT-ME-202	Introduction to Developmental Biology	2	1:30	25	25	50	2
BTP-ME-2b	Practical	4	4:00	25	25	50	2
	Total	6	5:30	**50**	**50**	**100**	**4**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-I

Minor Elective: BT-ME-101: Basics of Biochemistry

Course Code	BT-ME-101
Course Title	**Basics of Biochemistry**
Credits	2
Course Level	100-199
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The purpose of course to provide knowledge about physical and evolutionary foundation. It makes students to aware about pH meter, acids, bases, buffers and role of buffers in biological system.
Course Objectives	The objective of the course is to give knowledge about law of thermodynamics. Role of enzyme in regulations and functions of different buffer in body. Another objective is to provide knowledge regarding instrument, buffers, and enzyme activity.
Course Outcomes	CO 1: To learn evolution process of organisms as well as physical process. CO 2: To learn acids, base, pH, buffers and enzymes.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Fundamental understanding about science, biology and chemistry	
Course Content	**UNIT-1: Evolutionary and Physical Foundation** A possible RNA world scenario and evolution of eukaryotic cells. Dynamic steady state of living organisms. Energy transformation in living organisms. Flow of electrons as source of energy. Requirement of work and energy for creation and maintenance. Energy coupling links reactions in biology. Enzymes promote sequences of chemical reactions. Metabolism is regulated to achieve Balance and Economy.	Teaching Hours: 20
	UNIT-2: Concept of pH and types of Buffers Hydrogen ion concentration. Handerson-hasselbalch equation. Ionization of water. weak acids and weak bases. pH meter-instrumentation and application. pH scale. Buffer-definition. types & its preparation. buffers of biological importance. Mechanism of action of buffers in biological systems.	Teaching Hours: 10
Reference Books	• Cox, M. M., & Nelson, D. L., (2017) Lehninger: *Principles of Biochemistry*, 7th Edition, W.H. Freeman, New York. • Jain, J. L. (2004) Fundamentals of Biochemistry, S. Chand.	
e-learning resources	---	

Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

Minor Elective: BTP-ME-1a Practical

Course Code	BTP-ME-1a
Course Title	**Practical: Basics of Biochemistry**
Credits	2
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	The purpose of this course is to provide comprehensive understanding of buffer preparation, pH measurement, enzyme extraction and determination of enzyme activity.
Course Objective	The objective of this course is to equip students with the necessary knowledge and skills related to instrument, buffers, titration and enzyme activity.
Course Outcomes	Students are expected to know about how to calibrate pH meter and find out pH of solutions. To learn about buffer preparation. To gain vast knowledge about enzyme extraction, effect of various parameters on enzyme activity.
Mapping between COs with PSOs	
Pre-requisite	
Course Content	1. Preparation of 0.5 M solution. 2. Preparation of stock and working solutions. 3. Preparation of buffer solutions (Phosphate, Glycine-NaOH, Glycine-HCl). 4. Working principle of pH meter. 5. Estimation of xylose by orcinol method. 6. Estimation of proline by ninhydrine method. 7. Demonstration of enzyme extraction. 8. Titration curve of amino acids. 9. Effect of temperature on enzyme activity. 10. Effect of pH on enzyme activity.
Reference Books	• Shanmugam, S., Kumar, T. S. & Pareer Selvam K. (2019) Laboratory Handbook on Biochemistry, PHI Learning Pvt. Ltd. • Singh, R. (2000) Introductory Practical Biochemistry, Alpha Science International Ltd.
Teaching Methodology	Laboratory work, Journal preparation
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO 1-10								

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-I

Minor Elective: BT-ME-102: Ecological Studies

Course Code	BT-ME-102
Course Title	**Ecological Studies**
Credits	2
Course Level	100 to 199
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The basic knowledge (or facts) of ecosystems and ecosystem management are known as ecological notions. Ecological ideas serve as the foundation for ecological principles, which are fundamental presumptions (or beliefs) regarding ecosystems and how they work.
Course Objectives	The objective of this paper is to study the interactions between living things, such as humans, and their natural surroundings. It aims to comprehend the crucial interconnections that exist between living things such as plants, animals, and humans.
Course Outcomes	CO1: Students will gain knowledge of and interest in how nature works, how everything is connected, and how different aspects of an ecosystem can be integrated to create a functional environment. Studying the interactions between animals and plants as well as how human influence and climatic changes affect ecosystems are all included in this. CO2: Students will be able to understand how environmental factors and an organism's evolutionary past influence behaviour, which in turn influences evolutionary processes.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Basic Science	
Course Content	**UNIT-1: Population Ecology and Species Interactions** Characteristics of a population, Population growth curves, Population regulation, Life history strategies (*r* and *K* selection), Concept of meta-population, Types of interactions, intra and Interspecific competition.	Teaching Hours: 14

	UNIT-2: Animal Behaviour Introduction, Types and characteristics of Animal Behaviour, Types of Learning Behaviour Ecological Behaviour: Habitat-Food Selection, anti-predator mechanism, Aggregation, Territoriality and Dispersal Social Behaviour: Flocking in birds, herding in mammals, kin selection, altruism, inclusive fitness Reproductive Behaviour: Evolution of sex, Reproductive Strategies, Mating Systems, Courtship, Sperm Competition, Sexual Selection and parental care.	Teaching Hours: 16
Reference Books	• Eugene, O. P., & Gray, B. W. (2005). *Fundamentals of ecology* (5th ed). Cengage Learning, ISBN 978-81-315-0020-0. • Dash, M., & Dash, S. (2009). *Fundamentals of ecology*. McGraw-Hill Education, ISBN 978-0-07-008366-0. • Rockwood, L. L. (2015). *Introduction to population ecology, Wiley desktop editions series, (2)*. John Wiley & Sons Publications, ISBN 1118947576, 9781118947579.	
e-learning resources	*https://www.researchgate.net/publication/215622242_Textbook_of_Animal_Behaviour*	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

Minor Elective: BTP-ME-1b Practical

Course Code	BTP-ME-1b
Course Title	**Practical: Ecological Studies**
Credits	2
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	The purpose of ecological practical is to make small scale comparisons among biotic and abiotic community and relationship between different populations in respect to environment.
Course Objective	Students will able understand local and geographic distribution and abundance of an organism respect to living and non-living world.
Course Outcomes	CO1: To make familiar the students regarding community present in fresh water ecosystem and how they interact with environment. CO2: To provide practical knowledge on population density\diversity\richness present in surrounding environment. CO3: To sensitize students towards presence of repeated species present during environmental concerns, issues, and impacts of climate change and related mitigation strategies. CO4: To provide basic understanding to students that how animals response to various environmental stimulus.

<table>
<tr><td></td><td>CO5: To make the students to apply their knowledge for better description of population diversity (richness\evenness) present in ecosystem.
CO6: To sensitize students regarding relationship between weather condition and ecosystem
CO7: To improve student's observation regarding monitor biodiversity, conservation, restoration and sustainable management of nature
CO8: To sensitize students regarding presence or absence of animal biodiversity present in surrounding habitat.
CO9: To provide practical knowledge how to create miniature and enclosed ecosystem at laboratory level.
CO10: To make familiar the students how to enrich various microbes from sediments and soils.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td><table><tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr><tr><td>CO 1-10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table></td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>1. To study pond ecosystem.
2. Study the plant population density by quadrant method.
3. Study the plant population frequency by quadrant method.
4. Report writing on Animal Behaviour Experiment.
5. Estimation of species diversity by Shanon-Weiner diversity index method.
6. Measurement of atmospheric humidity.
7. Preparation of field report based on the survey of local flora.
8. Study the fauna of local area/college campus.
9. Constructions of Winogradsky's Column.
10. Measurement of primary productivity of water body.</td></tr>
<tr><td>Reference Books</td><td>• Patel, R. (2019) Experimental Microbiology vol 1 and vol 2, 5th ed. Aditya Publication.
• Aneja, K. R. (2014) Laboratory Manual of Microbiology and Biotechnology, MedTech, Scientific International Pvt. Ltd., New Delhi.</td></tr>
<tr><td>Teaching Methodology</td><td>Laboratory work, Journal preparation</td></tr>
<tr><td>Evaluation Method</td><td>50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative</td></tr>
</table>

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Minor Elective: BT-ME-201: Water Footprint

Course Code	BT-ME-201
Course Title	**Water Footprint**
Credits	2
Course Level	100-199
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	This course on "Water Footprint" aims to educate undergraduate science students on the intricacies of human-induced water consumption. By exploring the fundamentals of water footprint assessment, environmental impacts, and management strategies, students will gain a holistic understanding of the role of water in various sectors.
Course Objectives	1. Establish foundational knowledge on water footprint concepts and assessment tools. 2. Analyse the environmental impact of water use in agriculture, industry, and daily life. 3. Explore international water policies, governmental roles, and corporate responsibilities. 4. Investigate advanced topics such as water footprint in energy production and biodiversity implications. 5. Apply theoretical knowledge through practical projects and assessments.
Course Outcomes	CO1: Upon completion, students will possess a comprehensive understanding of water footprint dynamics, enabling them to assess and contribute to sustainable water management. CO2: They will develop critical thinking and problem-solving skills through hands-on projects, preparing them to address contemporary and future challenges related to water scarcity and environmental sustainability. The course equips students to become informed advocates for responsible water use in their scientific pursuits and broader societal roles.
Mapping between COs with 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>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Pre-requisite	Biology, Environmental Science
Course Content	**UNIT-1: Fundamentals of Water Footprint** Introduction to Water Footprint, Water Footprint Assessment Tools, Environmental Impact of Water Use, Water Footprint in Daily Life, Water Footprint Policies and Management — Teaching Hours:15 **UNIT-2: Advanced Topics and Applications** Water Footprint in Energy Production, Water Footprint and Biodiversity, Future Challenges and Solutions, Group Projects and Presentations, Assessment and Evaluation — Teaching Hours: 15
Reference Books	• Arjen Y. Hoekstra, Ashok K. Chapagain, Maite M. Aldaya and Mesfin M. Mekonnen (2011) The Water Footprint Assessment Manual, Earthscan [ISBN: 978-1-84971-279-8] • M. M. Mekonnen and A. Y. Hoekstra (2011) National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and

	Consumption. UNESCO-IHE Institute of Water Education, Netherlands. • Winne Gerbens-Leenes, Arjen Y. Hoekstra and Theo H. van der Meer (2009) The water footprint of bioenergy, PNAS, Vol. 106, No. 25, 10219-10223.
e-learning resources	• https://www.chaitanyaproducts.com/blog/water-footprints-india-2019-is-it-sustainable/ • https://www.waterfootprint.org/water-footprint-2/what-is-a-water-footprint/
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

Minor Elective: BTP-ME-2a Practical

Course Code	BTP-ME-2a
Course Title	**Practical: Water Footprint**
Credits	2
Course Level	100-199
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	The Water Footprint Practical Course is designed to provide undergraduate science students with practical, hands-on experiences related to water footprint assessment and management. The course aims to deepen students' understanding of the impact of human activities on water resources and instil practical skills to address water-related challenges.
Course Objective	The Water Footprint Practical Course aims to equip undergraduate science students with hands-on skills and knowledge in water footprint assessment and management. Through practical exercises, students will gain proficiency in using calculators, conducting field analyses, and proposing sustainable solutions. The course fosters critical thinking about the environmental impact of human activities on water resources, empowering students to contribute to sustainable water management globally.
Course Outcomes	Upon completion of the Water Footprint Practical Course, students will: 1. Acquire proficiency in using water footprint calculators, enhancing quantitative analysis skills. 2. Demonstrate a comprehensive understanding of water use in agriculture and propose sustainable irrigation practices. 3. Apply water audit techniques to assess and improve industrial water management strategies. 4. Evaluate the water footprints of food products, making informed choices for personal and environmental sustainability. 5. Understand the environmental impact of the textile industry and recommend sustainable alternatives.

	6. Compare and contrast the water footprints of energy sources, promoting awareness of renewable energy benefits. 7. Conduct biodiversity assessments and propose conservation measures for water ecosystems. 8. Simulate and analyse water scarcity scenarios, developing a holistic understanding of resource challenges. 9. Evaluate corporate water management practices, fostering an understanding of corporate responsibility. 10. Design, implement, and present water footprint reduction projects, showcasing practical problem-solving and communication skills.
Mapping between COs with 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 1-10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>
Pre-requisite	Biology, Environmental Science
Course Content	**1. Water Footprint Calculator Exploration (6 hours):** • Introduce students to various water footprint calculators. • Guide them through the process of calculating personal and household water footprints. • Discuss and compare results to understand the impact of daily activities. **2. Agricultural Water Use Analysis (6 hours):** • Conduct a field visit to a local farm or agricultural area. • Measure and analyse water use in irrigation systems. • Discuss sustainable agricultural practices to reduce water footprints. **3. Industry/Domestic/Corporate Water Audit (8 hours):** • Collaborate with local Institute/Organization for a water audit. • Calculate the water footprint. • Propose water-saving measures and assess their feasibility. **4. Food Consumption and Water Footprint (6 hours):** • Analyse food products' water footprints using life cycle assessments. • Evaluate the impact of dietary choices on personal water footprints. • Discuss strategies for sustainable and water-efficient food consumption. **5. Textile Industry Water Footprint (6 hours):** • Investigate water usage in the textile industry. • Calculate the water footprint of a specific textile product. • Explore textile sector to reduce water footprints. **6. Renewable Energy vs. Water Footprint (8 hours):** • Study the water footprints of different energy sources. • Compare renewable and non-renewable energy options. • Analyse the environmental implications of energy choices. **7. Biodiversity and Water Ecosystem Study (8 hours):** • Conduct a field visit to a local water ecosystem. • Assess the impact of human activities on biodiversity.

	• Propose measures to conserve water ecosystems and their biodiversity. **8. Water Scarcity Simulation (4 hours):** • Simulate water scarcity scenarios using a computer model. • Analyse the socio-economic impacts of water scarcity. • Discuss strategies for mitigating water scarcity challenges. **9. Corporate Water Footprint Analysis (6 hours):** • Collaborate with a local company for a water footprint analysis. • Evaluate corporate water management practices. • Suggest improvements for reducing the company's overall water footprint. **10. Water Footprint Reduction Project (8 hours):** • Divide students into groups to design water footprint reduction plans. • Implement projects based on real-world scenarios or hypothetical situations. • Present and discuss the effectiveness of the proposed solutions.
Reference Books	• Arjen Y. Hoekstra, Ashok K. Chapagain, Maite M. Aldaya and Mesfin M. Mekonnen (2011) The Water Footprint Assessment Manual, Earthscan [ISBN: 978-1-84971-279-8] • M. M. Mekonnen and A. Y. Hoekstra (2011) National Water Footprint Accounts: The Green, Blue and Grey Water Footprint of Production and Consumption, UNESCO-IHE Institute of Water Education, Netherlands. • Winne Gerbens-Leenes, Arjen Y. Hoekstra and Theo H. van der Meer (2009) The water footprint of bioenergy, PNAS, Vol. 106, No. 25, 10219-10223.
e-learning resources	• https://www.chaitanyaproducts.com/blog/water-footprints-india-2019-is-it-sustainable/ • https://www.waterfootprint.org/water-footprint-2/what-is-a-water-footprint/
Teaching Methodology	Laboratory work, Journal preparation
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Minor Elective: BT-ME-202: Introduction to Developmental Biology

Course Code	BT-ME-202
Course Title	**Introduction to Developmental Biology**
Credit	2
Course Level	100-199
Total engagement	2 Credits x 15 Hours = 30 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	Developmental biology is a branch of biology that focuses on understanding how multicellular organisms develop from a single fertilized egg (zygote) into complex, organized structures with specialized functions. The purpose of developmental biology is to study and elucidate the processes that govern the growth, differentiation, and morphogenesis of organisms throughout their life cycles.
Course Objective	The objective of a developmental biology course is to provide students with a deep understanding of the intricate processes that govern how organisms develop from a single fertilized egg into complex, functional structures. Throughout this course, students delve into the fundamental principles of embryogenesis, cell differentiation, and organ formation.
Course Outcomes	CO1: Students will acquire the knowledge the stages of development from fertilization through adulthood, and identify the factors and events that influence each stage CO2: Understanding of the key concepts and principles in plant developmental biology.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Basic Science	
Course Content	**UNIT-1: An Introduction to Early Developmental Processes** Cleavage, Patterns of cleavage: Holoblastic cleavage and Meroblastic cleavage, Gastrulation, Axis-formation	Teaching Hours:15
	UNIT-2: Basic concepts of plant development Plant Life Cycles, Gamete Production in Angiosperms, Pollen Structure, The ovary, Pollination, Fertilization, Seed Dormancy, Seed Germination.	Teaching Hours:15
Reference Books	• Gilbert S. F. (2011). Developmental Biology 9th Edition. Sinauer Associates. ISBN: 978-0878933846 • Twyman, R. M. (2003). Developmental Biology. Bios Scientific. ISBN 978-8176492379	
e-learning resources	• https://plato.stanford.edu/entries/biology-developmental/	

	• https://www.britannica.com/science/biological-development
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

Minor Elective: BTP-ME-2b: Practical

Course Code	BTP-ME-2b
Course Title	**Practical: Introduction to Developmental Biology**
Credits	2
Course Level	100-199
Total Engagement	2 Credits x 30 Hours = 60 Hours
Teaching per week	2 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	To provide undergraduate students with the opportunity to observe and understand the processes involved in the development of animal and plant. Hands-on experiments and observations allow students to witness developmental stages, morphological changes in real-time.
Course Objective	Course objectives for a Plant and Animal Development course typically aim to provide students with a comprehensive understanding of the principles, processes, and mechanisms involved in the growth and development of plants and animals. These objectives aim to provide students with a solid foundation in the principles of plant and animal development, from molecular mechanisms to the organismal level, while also fostering practical skills and an appreciation for the diversity of developmental processes in the biological world.
Course Outcomes	Upon completion of the developmental biology Practical Course, students will: 1. Understand the depth that how media preparation will be done and importance of each component present in media 2. Students will acquire the knowledge of how plant will grow from undifferentiated cell under the laboratory conditions. 3. This experiment allows students to explore the impact of temperature conditions on seed germination and seedling development, providing valuable insights into the role of temperature in plant growth. 4. Students to explore the impact of light conditions on seed germination and seedling development, providing valuable insights into the role of light in plant growth. 5. This experiment allows students to explore the impact of pH conditions on seed germination and seedling development, providing valuable insights into the role of pH in plant growth. 6. Students to draw conclusions, and discuss the factors affecting seed dormancy based on their experimental results. This hands-on approach provides a practical understanding of seed dormancy and

<table>
<tr><td></td><td>the factors influencing seed germination.
7. Students will explore the principles and study their life cycles and observe developmental changes at different stages in C. elegans/Zebra Fish/ Chick embryo/Human Embryo.
8. The students will be able to study cleavage pattern in model organism Frog.
9. Permanent slides serve as valuable resources for education, research, and the ongoing exploration of the complexities of developmental biology.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO 1-10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Pre-requisite</td><td>Basic Science</td></tr>
<tr><td></td><td>1. To study media preparation for plant development studies.
2. To study callus culture.
3. Seed germination: Experiments on seed germination under different temperature conditions
4. Seed germination: Experiments on seed germination under different light conditions
5. Seed germination: Experiments on seed germination under different pH conditions
6. To study seed dormancy.
7. To determine Developmental stages in C. elegans/Zebra Fish/ Chick embryo/Human Embryo (demonstration)
8. To study different type of cleavage in frog.
9. To study permeant slides (ovaries and sperm)</td></tr>
<tr><td>Reference Books</td><td>• Pandey, B. P. (1999). Modern Practical Botany-Volume II. S. Chand Publishing.
• Kumar, U., & Kumar, U. (2011). Methods in plant tissue culture. Agrobios (India).</td></tr>
<tr><td>e-learning resources</td><td>• https://www.sciencedirect.com/science/article/abs/pii/S2214786122000341
• https://academic.oup.com/aob/article/101/2/293/185992</td></tr>
<tr><td>Teaching Methodology</td><td>Laboratory work, Journal preparation</td></tr>
<tr><td>Evaluation Method</td><td>50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative</td></tr>
</table>

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty): Multidisciplinary Course

Teaching & Evaluation Scheme
Semester-I & II

[Academic Year of Implementation 2023-2024]

Semester-I

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-MDC-101	Basic Healthcare	4	2:30	50	50	100	4
	Total	4	2:30	50	50	100	**4**
BT-MDC-102	Introduction to Bioinformatics and Databases	4	2:30	50	50	100	4
	Total	4	2:30	50	50	100	**4**

Semester-II

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-MDC-201	Evolutionary Biology	4	2:30	50	50	100	4
	Total	4	2:30	50	50	100	**4**
BT-MDC-202	Environmental Biology and Wildlife	4	2:30	50	50	100	4
	Total	4	2:30	50	50	100	**4**
BT-MDC-203	Basics of Bioinformatics	4	2:30	50	50	100	4
	Total	4	2:30	50	50	100	**4**
BT-MDC-204	Bioinstrumentation	4	2:30	50	50	100	4
	Total	4	2:30	50	50	100	**4**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-I

Multidisciplinary Course: BT-MDC-101: Basic Healthcare

Course Code	BT-MDC-101
Course Title	**Basic Healthcare**
Credits	4
Course Level	100-199
Total engagement	4 Credits x 15 Hours = 60 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	This course is for all students who wants to learn fundamental concepts related to self-care and care for others which gives them confidence to take immediate actions during emergencies. Basic health Care course orients learner to understand some important aspects to take care and steps in case of various types of health related emergencies.
Course Objectives	-To understand basic concepts of First aid, this can help to society as well as own self. -Person can deal with current emergency situation on quick base. -Knowledge of First aid can save life or may give temporary relief to prevent worst situation in absence of health professional. -It helps to realize moral duties and values.
Course Outcomes	CO1: Students will able to learn about primary aid skills. CO2: Student will deal to handle present emergency situation with confidence. Students will develop basic skill which is needed to assess the ill or injured person. CO3: Students will able to take logical decisions and shall be able to take appropriate immediate actions. Hospital visit is included for brief practical understanding and to visualize demonstration by expert regarding first aid.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								
CO3								

Pre-requisite	Biology; Chemistry; Public Health; Ethics; Medical Terminology	
Course Content	**UNIT-1: Preparing to Help (First Aid)** First Aid Techniques; Aim and The Law; Dealing with an Emergency; Stress when giving First Aid and Resuscitation; Primary and Secondary Assessment; Hygiene and Hand Washing.	Teaching Hours: 15
	UNIT-2: Medical Emergencies Heart, Blood Circulation, Shock; GI tract, Diarrhoea, Food Poisoning and Diabetes; Respiratory System and Breathing; Nervous System and Unconsciousness; Urinary System, Reproductive System and Emergency Childbirth; Senses, Foreign Bodies in Eye, Ear, Nose or Skin and Swallowed Foreign Objects.	Teaching Hours: 15

	Unit 3: Injury Emergencies Control of Bleeding; Burns: Thermal, Electrical and Chemical; Head, Neck and Back injuries; Minor Injuries: Nosebleed, Injured Tooth; Wounds; Bones, Joints and Muscles.	Teaching Hours: 15
	UNIT-4: Environmental Emergencies Heat and Cold Emergencies; Bites and Stings; Poisoning and Poisonous Plants; Lightning; Emotional Considerations; Visits to Hospital.	Teaching Hours: 15
Reference Books	• Indian First Aid Manual (2016) 7th Edition, Indian Red Cross Society. • Basic First Aid, Student book, version 8.0, American Safety and Health Institute, ISBN 978-1-936515-64-6, 1st Edition (2016)	
e-learning resources	• https://www.indianredcross.org/publications/FA-manual.pdf • https://www.emcmedicaltraining.com/wp-content/uploads/2016/09/ashi-first-aid-student-book.pdf	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-I

Multidisciplinary Course: BT-MDC-102: Introduction to Bioinformatics and Databases

Course Code	BT-MDC-102
Course Title	**Introduction to Bioinformatics and Databases**
Credits	4
Course Level	100-199
Total engagement	4 Credits x 15 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The purpose of the course is to give knowledge to the students regarding the fundamentals of bioinformatics and databases using computers.
Course Objectives	Any use of tools and databases is based on bioinformatics. Biological databases are becoming more and more importance in today life for better knowledge.
Course Outcomes	CO1: The student will be able clarify the fundamentals of computer including applications, generations, components, hardware, softwares and networking. CO2: The student will be able to get knowledge of basic bioinformatics and various biological databases.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Biology; Chemistry; Computer Science	
Course Content	**UNIT-1: Computer Fundamentals - 1** Overview, Applications, Generations and its types; Components, CPU, Input Devices and Output Devices; Memory, RAM, ROM, Motherboard, Memory units and Ports.	Teaching Hours: 15
	UNIT-2: Computer Fundamentals - 2 Hardware and Software; Number system, Number Conversion, Data and Information; Networking, Operating System, Internet and Intranet.	Teaching Hours: 15
	UNIT-3: Introduction to Bioinformatics What is Bioinformatics and its applications; Scope of Bioinformatics; Structure visualizing tools; Examples of related tools (FASTA, BLAST, RASMOL, SWISS PORT, Cn3D).	Teaching Hours: 15
	UNIT-4: Biological Databases General Introduction of Biological Databases; Nucleic acid databases (NCBI, GENBANK, PubMed, DDBJ and EMBL); Protein databases (PDB and MMDB); Structure databases (CATH, SCOP and PDBsum); Metabolic pathway databases (KEGG)	Teaching Hours: 15
Reference Books	• E. Balagurusamy (2009), *Fundamentals of Computers*, Tata McGraw Hill Education Private Limited, New Delhi, ISBN 13: 978-0-07-014160-5	

	• S. C. Rastogi (2018), *Bioinformatics Methods and Applications (Genomics, Proteomics and Drug Discovery)*, PHI Learning Private Limited, Delhi, ISBN 978-81-203-4785-4
e-learning resources	https://www.tutorialspoint.com/computer_fundamentals/index.htm https://www.ncbi.nlm.nih.gov/ https://www.embl.org/ https://www.rcsb.org/ https://www.cathdb.info/ https://scop.mrc-lmb.cam.ac.uk/ https://www.genome.jp/kegg/
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Multidisciplinary Course: BT-MDC-201: Evolutionary Biology

Course Code	BT-MDC-201
Course Title	**Evolutionary Biology**
Credit	4
Course Level	100-199
Total engagement	4 Credits x 15 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The goal of this course is to introduce students with a very basic knowledge and understanding of the Evolutionary biology: Some theories of Evolution, Direct-indirect Evidences of Evolution & regarding population ecology.
Course Objective	The course will stand on its utility towards learning and implementing the aspects towards Evolutionary Biology.
Course Outcomes	The student at the completion of the course will be able to **CO1**: Understand the Theories of Lamarckism; Neo-Lamarckism, Theory of Natural Selection, Modern Synthetic Theory, Weismann's Germ Plasm Theory, Mutation Theory **CO2**: To be familiar with fossils & also know about the geological time-table. **CO3**: Students will acquire detailed knowledge of Indirect evidences of Evolution. **CO4:** To understand about population ecology.

Mapping between COs with PSOs

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

Pre-requisite	Fundamental Biology	
Course Content	**UNIT-1: Theories of Organic Evolution** Theories of Inheritance of Acquired Character: Lamarckism; Neo-Lamarckism, Theory of Natural Selection, Modern Synthetic Theory, Weismann's Germ Plasm Theory, Mutation Theory	Teaching Hours:15
	UNIT-2: Direct Evidences of Evolution: Fossils Palaeontological Evidences, Fossils, Nature and Types of Fossils, The Geological Time Table	Teaching Hours:20

	UNIT-3: Indirect Evidences of Evolution Evidences from Comparative Anatomy: Connecting Link; Homology; Analogy; Vestigial Organs, Evidences from Comparative Embryology, Evidences from Comparative Physiology and Biochemistry	Teaching Hours:15
	UNIT-4: Population Ecology Population Characteristics, Vital Index and Survival Curves, Population Dynamics, Growth Rate, Population Dispersion	Teaching Hours:10
Reference Books	P. S. Verma and V, K Agarwal (2010) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, *S. Chand Publication*, ISBN 81-219-2442-1.	
e-learning resources	• https://www.britannica.com/science/evolution-scientific-theory • http://www.researchgate.net/publication/335339827_Life_Sciences_Fundamentals_and_Practce_Vol_II_Seventh_Edition	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Multidisciplinary Course: BT-MDC-202: Environmental Biology and Wildlife

Course Code	BT-MDC-202
Course Title	**Environmental Biology and Wild life**
Credits	4
Course Level	100-199
Total engagement	4 Credits x 15 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The course "Environmental Biology and Wildlife" is designed to provide students with a comprehensive understanding of the interconnections between living organisms and their natural environment.
Course Objectives	Through this course, students will explore the intricate relationships and ecological processes that shape the delicate balance of ecosystems. By merging principles from biology and ecology, students will develop a holistic perspective on environmental and the importance of wildlife diversity.
Course Outcomes	CO1: Students will be able to learn about scope and objectives of ecology. CO2: Students will learn about conservation of natural resources. CO3: Students will be familiar with different sources of energy. CO4: Students will acquire knowledge of wild life conservation and its importance.
Mapping between COs with PSOs	

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

Pre-requisite	Biology; Chemistry; Public Health; Ethics; Medical Terminology	
Course Content	**UNIT-1: Ecology and Environment** Definition and objectives of ecology, Subdivisions of ecology, Scope of ecology, Structural, Functional and Evolutionary concepts of ecology.	Teaching Hours: 10
	UNIT-2: Ecology and Human Welfare Conservation of natural resources, Energy and its conservation, Food, Agriculture and Aquaculture, Forestry.	Teaching Hours: 15
	UNIT-3: Resources and energy Introduction, Solar energy, wave and wind power, liquid hydrogen, energy plantations, liquid fuels from waste, biogas technology, biological conversion of waste.	Teaching Hours: 15

	UNIT-4: Wild-life Management Wild life of India, Reasons for depletion of wild life, Necessity for wild life conservation, Modes of wild life conservation, Conservation of flora and fauna-endangered species and forest resources.	Teaching Hours: 20
Reference Books	1. Verma PS and Agarwal PK (2015). Environmental Biology, S. Chand Publications, New Delhi. 2. Subrahmanyam NS and Sambamurty AVSS (2008). Ecology (Second Edition), Narosa Publishing House, New Delhi.	
e-learning resources	Biosphere (nationalgeographic.org)	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Multidisciplinary Course: BT-MDC-203: Basics of Bioinformatics

Course Code	BT-MDC-203	
Course Title	**Basic of Bioinformatics**	
Credits	4	
Course Level	100-199	
Total engagement	4 Credits x 15 Hours = 60 Hours	
Teaching per week	4 h	
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)	
Effective from	2023-2024	
Purpose of Course	The purpose of the course is to give knowledge to the students regarding the fundamentals of computer and bioinformatics.	
Course Objectives	Any use of tools and databases is based on bioinformatics. Biological databases are becoming more and more importance in today life for better knowledge.	
Course Outcomes	CO1: The student will be able clarify the fundamentals of computer including applications, generations, components, hardware, softwares and networking. CO2: The student will be able to get knowledge of basic bioinformatics and various biological databases.	
Mapping between COs with PSOs		
Pre-requisite	Biology; Chemistry; Computer Science	
Course Content	**UNIT-1: HTML** Introduction to HTML, Working of HTML, Creating and loading HTML pages, tags, Structure of on HTML, Document, Stand Alone Tags, formatting text, Adding Images, Creating hyper Links, Tables.	Teaching Hours: 15
	UNIT-2: MS Office MS-Word: Introduction, Starting MS-Word Screen and its Components, Elementary Working with MS-Word. MS-Excel: Introduction, Starting MS-Excel, Basics of Spreadsheet, MS- Excel Screen and its Components, Elementary Working with MS-Excel. MS-Power Point: Introduction, Starting MS-PowerPoint, Basics of PowerPoint, MS-PowerPoint Screen and its Components, Elementary Working with MS-PowerPoint.	Teaching Hours: 15
	UNIT-3: Pair-Wise Sequence Alignment Sequence Alignments, its types and importance. Method of Sequence Alignment - Dot Matrix Analysis, Dynamic Programming Methods (Local alignment and Global alignment), Heuristic Methods.	Teaching Hours: 15
	UNIT-4: Multiple Sequence Alignment Introduction and Application of Multiple Sequence Alignment. Methods of Multiple Sequence Alignment - Sum of Pair Method, Progressive Alignment Method (Clustalw), Iterative Alignment Method. Gap penalty - its types and significance.	Teaching Hours: 15

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Reference Books	• E. Balagurusamy (2009), *Fundamentals of Computers*, Tata McGraw Hill Education Private Limited, New Delhi, ISBN 13: 978-0-07-014160-5 • S. C. Rastogi (2018), *Bioinformatics Methods and Applications (Genomics, Proteomics and Drug Discovery)*, PHI Learning Private Limited, Delhi, ISBN 978-81-203-4785-4
e-learning resources	https://www.tutorialspoint.com/computer_fundamentals/index.htm https://www.ncbi.nlm.nih.gov/ https://www.embl.org/ https://www.rcsb.org/ https://www.cathdb.info/ https://scop.mrc-lmb.cam.ac.uk/ https://www.genome.jp/kegg/
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Multidisciplinary Course: BT-MDC-204: Bioinstrumentation

Course Code	BT-MDC-204
Course Title	**Bioinstrumentation**
Credits	4
Course Level	100-199
Total engagement	4 Credit x 15 Hours = 60 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	The course aims to provide basic knowledge to students pursuing careers in Life Sciences, Biotechnology, Microbiology and healthcare. Additionally, the course fosters an interdisciplinary approach, showcasing how the integration of various instruments and techniques contributes to a deeper understanding of biological systems
Course Objectives	The course on Bioinstrumentation aims to provide students with a foundational understanding of various instruments and techniques used in the field of Biology. The students will learn basic principles of Microscopy and different Analytical techniques.
Course Outcomes	CO1: Students will learn, basics of Microscopy and different types of Microscopes. CO2: Students will be introduced to different analytical techniques, which are widely used for research biological sciences
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	12^{th} Pass with Basic Science.	
Course Content	**UNIT-1: Basic Microscopy** Principles of Microscopy, Magnification, resolving power, numerical aperture. Working principle and applications of Bright field microscope, Dark field microscope, Phase contrast microscope and DIC microscope. Preparation and staining of specimen.	Teaching Hours: 15
	UNIT-2: Advanced Microscopy Working principle and applications of Fluorescence microscope, Confocal microscope, Electron microscope - TEM and SEM, Specimen preparation for SEM and TEM.	Teaching Hours: 15
	UNIT-3: Introduction to chromatography Introduction and working principles of paper chromatography, liquid chromatography, affinity chromatography and gas chromatography.	Teaching Hours: 15

	UNIT-4: Introduction to centrifugation Sedimentation, Centrifugal force, principle and working of centrifuge, different types of centrifuges, types of rotors used in centrifuge.	Teaching Hours: 15
Reference Books	• Keith Wilson & John Walker (ED) (2000) Practical biochemistry-Principle and Techniques. Cambridge University Press. • Robards K, Haddad P.R & Jackson P.E (1994) Principles and practice of modern chromatographic methods, Academic press London. • Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's microbiology. McGraw-Hill.	
e-learning resources	Techniques of Materials Characterization - Course (nptel.ac.in)	
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment	
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty):
Skill Enhancement Course

Teaching & Evaluation Scheme
Semester-I & II
[Academic Year of Implementation 2023-2024]

Semester-I

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-SEC-101	Bacteriological Media and Isolation Techniques	Theory 1	1:00	13	13	26	1
		Practical 2	2:00	12	12	24	1
	Total	**3**	**3:00**	**25**	**25**	**50**	**2**
BT-SEC-102	Study of Soil Profile	Theory 1	1:00	13	13	26	1
		Practical 2	2:00	12	12	24	1
	Total	**3**	**3:00**	**25**	**25**	**50**	**2**

Semester-II

Course Code	Course Title	Teaching Schedule Hours/Week	Exam Duration & Marks			Total Theory/Practical Marks	Credit
			Duration (Hours: Minutes)	(CCE) Internal Marks	(SEE) External Marks		
BT-SEC-201	Introduction to Staining Techniques	Theory 1	1:00	13	13	26	1
		Practical 2	2:00	12	12	24	1
	Total	**3**	**3:00**	**25**	**25**	**50**	**2**
BT-SEC-202	Aquarium Fish Rearing	Theory 1	1:00	13	13	26	1
		Practical 2	2:00	12	12	24	1
	Total	**3**	**3:00**	**25**	**25**	**50**	**2**

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-I

Skill Enhancement Course: BT-SEC-101: Bacteriological Media and Isolation Techniques

Course Code	BT-SEC-101
Course Title	Bacteriological Media and Isolation Techniques
Credits	2 (1 credit theory & 1 credit practical)
Course Level	100-199
Total engagement	1 Credit x 15 Hours + 1 Credit x 30 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	This course will give students the introduction, necessity, composition and types of media, isolation techniques and practical skills regarding the preparation of culture media and other basic handling skills required in a lab.
Course Objectives	-To help understand the role of various nutrients in growth of organisms. -To create awareness regarding media preparation. - Types of media formed - Various techniques for the isolation of pure culture.
Course Outcomes	CO1: Students will gain knowledge about media, its ingredients, role, types and various techniques for isolation of pure culture. CO2: Students will gain skills regarding media preparation, cleaning and sterilizing of glassware and media, how to prepare a smear, how to stain a smear and how to perform serial dilution.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	12th Pass with Biology & Chemistry	
Course Content	**UNIT-1: Nutritional requirements and cultivation media** Introduction to Nutritional requirement and chemical elements required, Steps in preparation of media, Introduction and Basal Ingredients of culture media, Types of media (Solid, Semi-solid and Liquid), Techniques for isolation of pure culture-Single cell, serial dilution, pour plate, streak plate and spread plate techniques.	Teaching Hours: 15
	UNIT-2: Practical 1. Preparation of Culture media (Solid, Semi-solid and Liquid). 2. Cleaning and Sterilization of glassware and media. 3. Preparation, fixation and monochrome staining of a smear. 4. Preparation of Serial dilution. 5. Demonstration of different isolation techniques.	Teaching Hours: 30
Reference Books	• Dubey, M. (2009) *Practical Microbiology.* New Delhi: S. Chand. • Srivastava, M. L. (2008) *Microbial Biochemistry.* Narosa Publishing House. • Madigan, B. B. (2019) *Brock Biology of Microorganisms* (5 ed.). Pearson.	

	• Rakesh Patel, K. P. (2016) *Experimental Microbiology* (9 ed., Vol. I). Aditya Publication.
e-learning resources	https://www.youtube.com/dbtvnsgu
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-I

Skill Enhancement Course: BT-SEC-102: Study of Soil Profile

Course Code	BT-SEC-102
Course Title	Study of Soil Profile
Credits	2 (1 credit theory & 1 credit practical)
Course Level	100-199
Total engagement	1 Credit x 15 + 1 Credit x 30 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	This course is for all students who wants to learn fundamental concepts related to understand Formation of soil and Properties of soil. Also, to learn about soil organism correlation.
Course Objectives	- This paper is meant to make students understand the importance of soil in agriculture and soil science. - Student will know various physical and chemical properties of soil. Also, will know about soil biology soil microbes' interaction.
Course Outcomes	CO1: Students will able to define soil texture. CO2: They can identify soil types accordingly to texture characteristics. CO3: They can identify source of organic matter in soil. CO4: They will able to define soil pH. CO5: Identify types of soil organisms and their functions within a soil ecosystem.

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	12th Pass with Biology and Chemistry	
Course Content	**UNIT-1: Soil Profile** What is soil? Weathering-Formation of soil, Soil formation factors and processes, Soil Profile, Soil biology, Soil physical properties, Soil Structure and Consistency, Soil water, Concept of Soil pH and Nutrient Availability, Soil organic matter.	Teaching Hours: 15
	Practical: 1. Determination of Soil pH 2. Identification of soil texture- clay, sand, loamy by sieve method. 3. Identification of soil types-red soil, black soil. 4. Analysis of soil organic matter. 5. Microbiological analysis of soil (SPC/TVC)	Teaching Hours: 30
Reference Books	• Mehra, R. K. (2011). *Textbook of Soil Science*. Indian Council of Agricultural Research. • Brady, N. C., Weil, R. R., & Weil, R. R. (2008). *The nature and properties of soils* (Vol. 13, pp. 662-710). Upper Saddle River, NJ: Prentice Hall.	

e-learning resources	• https://agrimoon.com/wp-content/uploads/Fundamentals-of-Soil-Science-with-Practicals.pdf • https://agrigyan.in/fundamentals-of-soil-science-pdf-download-free/#preview-download-pdf • https://www.agriexam.com/introduction-to-soil-science-book-pdf
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Skill Enhancement Course: BT-SEC-201: Introduction to Staining Techniques

Course Code	BT-SEC-201
Course Title	**Introduction to Staining Techniques**
Credits	2 (1 credit theory & 1 credit practical)
Course Level	100-199
Total engagement	1 Credit x 15 Hours + 1 Credit x 30 Hours = 45 Hours
Teaching per week	3 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	This course will give students the introduction of stains, different staining methods, special staining and how to visualize different types of microbial structure. Also will help to develop practical skills to handle, stain and visualize microbes using microscope.
Course Objectives	- To understand various types of staining techniques - To create awareness regarding how each technique differs from other - Techniques used for differentiation of microbes - Techniques for visualization of different structures in microbes and fungus.
Course Outcomes	CO1: Students will gain knowledge about stains, different staining techniques, how to differentiate between microbes, staining techniques to observe structures in microbes and fungus. CO2: Students will gain skills regarding stain preparation, bacterial staining & differentiation, and staining of internal structures.
Mapping between COs with PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Biology; Chemistry.	
Course Content	**UNIT-1: Introduction to Staining Techniques** Introduction and types of staining techniques (direct, indirect, progressive, regressive, vital, monochrome, differential, structural, impregnation), Differential staining (Gram stain, Acid fast stain), Special staining (Cell wall, Capsule, Endospore), Staining of fungus (Lacto phenol Cotton Blue Wet mount), Staining of Nucleus (Giemsa, Feulgen).	Teaching Hours: 15
	UNIT-2: Practical 6. Negative staining. 7. Gram's staining of microbial culture. 8. Acid fast staining by Ziehl-Neelson method. 9. Cell wall staining. 10. Capsule staining. 11. Endospore staining. 12. Nucleus staining.	Teaching Hours: 30

Reference Books	• Anderson, D., Salm, S., Allen, D., & Nester, E. (2016). *Nester's Microbiology- A Human Perspective* (8th ed.). McGraw Hill Education. • Aneja, K. (2014). *Laboratory Manual of Microbiology and Biotechnology* (1st ed.). MedTech. • Dubey, M. (2009) *Practical Microbiology*. S.CHAND. • Patel, R., & Patel, K. (2022). *Lecture notes on Introduction to Microbiology*. Aditya Publication. • Patel, R., & Patel,K P. (2016) *Experimental Microbiology* (9 ed., Vol. I). Aditya Publication.
e-learning resources	https://www.youtube.com/dbtvnsgu
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

Undergraduate Program (Science Faculty)

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

Semester-II

Skill Enhancement Course: BT-SEC-202: Aquarium Fish Rearing

Course Code	BT-SEC-202
Course Title	**Aquarium Fish Rearing**
Credits	2 (1 credit theory & 1 credit practical)
Course Level	100-199
Total engagement	1 Credit x 15 Hours +1 Credit x 30 Hours = 45 Hours
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including classwork, examination, preparation & holidays)
Effective from	2023-2024
Purpose of Course	This course is for all Students will be able to know the fundamentals of aquarium fish industry. Also, to understand the biological features of aquarium fishes.
Course Objectives	- This paper is meant to make students will be able to know the fundamentals of different aquarium fishes. - Student will get to know the food and feeding habits of aquarium fishes. Also, will get aware about transportation of fishes.
Course Outcomes	CO1: Students will manage the home as well as public (commercial) aquariums, learn to handle different aquarium tools accessories. CO2: To determine appropriate species of fishes and plant life to be introduced into an aquarium and prepare the proper dosage of different kinds of natural and synthetic fish feed. Also, will identify common health problems with fish in an aquarium

Mapping between COs with PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1								
CO2								

Pre-requisite	Introduction to Aquarium Fish Keeping; Fresh water and Marine Aquarium fishes; Food and Feeding of Aquarium Fishes: Fish Transportation	
Course Content	**UNIT-1:** Introduction to Aquarium Fish Keeping, Construction, setting and maintenance of aquaria (Fabrication: frame - glass, size, Aquarium accessories: Heaters, thermostat, aerators, water filters etc). Water quality and fish health management (Abiotic components, Biotic components, Aquarium plants: Rooted, Branched, Floating. Aquarium fish diseases symptoms and treatment), Common characters and sexual dimorphism of Fresh water and Marine Aquarium fishes such as (Molly, Sword tail, Gold fish, Angel fish, blue morph, Anemone fish and Butterfly fish), Food and Feeding of Aquarium Fishes, Fish Transportation and Maintenance	Teaching Hours: 15
	Practical: 1. Setting up of an aquarium. 2. Comparative estimation of amount of DO, NH_3 in water samples. 3. Study of different ornamental fishes-both fresh and marine water. 4. Study of different Aquarium fish diseases. 5. Visit of aquarium	Teaching Hours: 30

Reference Books	• "Aquarium Fish" by Andrew cleave • "Ornamental Fish Culture and Aquarium Management" by A.D. Dholakia. Daya Publishing House
e-learning resources	• https://www.vet-ebooks.com/encyclopedia-of-aquarium-and-pond-fish/ • https://kvknorthgoa.icar.gov.in/fishdb/pub/TB69.pdf
Teaching Methodology	Classwork, Discussion, Self-Study, Projects, Seminars and/or Assignment
Evaluation Method	50% CCE (Continuous and Comprehensive Evaluation)-Formative & 50% SEE (Semester End Evaluation)-Summative