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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-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન બાયોટેકનોલોજી વિષય ચલાવતી અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓને તથા ડિપાર્ટમેન્ટના વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૨–૨૩ થી અમલમાં આવનાર M.Sc. Biotechnology સેમેસ્ટર–૭ અને ૮ નો પેટાસમિતિએ તૈયાર કરેલ અભ્યાસક્રમ બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૫/૧/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ૨ અન્વયે નીચે મુજબ ભલામણ કરેલ જે વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખા વતી વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ મંજુર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલએ તેની તા.૩૦/૦૧/૨૦૨૩ની સભાના **ઠરાવ** ક્રમાંકઃ૧૧ અન્વયે સ્વીકારી મંજૂર કરેલ છે. તેની જાણ સંબંધકર્તા શિક્ષકો અને વિદ્યાર્થીઓને કરવી, તદ્ઉપરાંત તેનો અમલ કરવો.

બાયોટેકનોલોજી વિષયની નિયુક્ત એડહોક સમિતિની તા.૦૫/૦૧/૨૦૨૩ની સભાનાં ભલામણ ક્રમાંકઃ૨

:: આથી ઠરાવવામાં આવે છે કે,શૈક્ષણિક વર્ષ–૨૦૨૨–૨૩થી અમલમાં આવનાર બાયોટેકનોલોજી પ્રોગ્રામના M.Sc. Semester - VII અને VIII નો પેટાસમિતિએ તૈયાર કરેલ અભ્યાસક્રમ મંજૂર કરી તે મંજૂર કરવાવિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૩૦/૦૧/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ ૧૧

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૨–૨૩ થી અમલમાં આવનાર M.Sc. Biotechnology સેમેસ્ટર–૭ અને ૮ નો પેટા સમિતિએ તૈયાર કરેલ અભ્યાસક્રમ સંદર્ભે બાયોટેકનોલોજી વિષયની અભ્યાસ સમિતિની તા.૫/૧/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૨ અન્વયે નીચે મુજબ ભલામણ કરેલ જે વિજ્ઞાન વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિજ્ઞાન વિદ્યાશાખાવતી વિજ્ઞાન વિદ્યાશાખાનાં અધ્યક્ષશ્રીએ મંજુર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંક : એસ/પરિપત્ર/સિલેબસ/૨૭૪૬/૨૦૨૩
તા. ૦૧–૦૨–૨૦૨૩

કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન બાયોટેકનોલોજી વિષય ચલાવતી અનુસ્નાતક કોલેજોનાં આચાર્યશ્રીઓ તથા ડિપાર્ટમેન્ટનાં વડાશ્રી.
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

M. Sc. Integrated Biotechnology

[Academic Year of Implementation: 2022-2023; Modified January 2023]

Teaching and Examination Scheme for Semester-VII

Course Code	Paper	Teaching Schedule Hours/Week	Exam Schedule			Total Theory/Practical (Marks)	Credits
			Duration (Hours)	Internal Marks	External Marks		
	Theory papers:						
BT-101	**Core Paper I:** Advances in Cell Biology	4	3	30	70	100	4
BT-102	**Core Paper II:** Plant and Animal Biotechnology	4	3	30	70	100	4
BT-103	**Core Paper III:** Enzyme Biotechnology	4	3	30	70	100	4
BT-104 BT-104	**Elective Paper-I** Environmental Biotechnology **Elective Paper-II** Advances in Nanobiotechnology	4	3	30	70	100	4
	Practical:						
BT-105	**Practical** based on 101 to 104	12	4 h X 3 days = 12 h	50	100	150	6
BT-106	**Skill Based Elective Paper:** Techniques for Genetic Testing and Sequencing /SWAYAM/ MOOC courses	2	2	20	30	50	2
	Total			190	410	600	24

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-101: Advances in Cell Biology

<table>
<tr><td>Course Code</td><td>BT-101</td></tr>
<tr><td>Course Title</td><td>Advances in Cell Biology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The purpose is to make students aware with cell structure and functions and give them insights of vascular trafficking and intracellular signalling</td></tr>
<tr><td>Course Objective</td><td>The objective of this is course are to sensitize the students to the fact that as we go down the scale of magnitude from cells to organelles to molecules, the understanding of various biological processes becomes deeper and inclusive.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: It enlightens students about advanced types of microscopic techniques.
CO2: It will give idea regarding protein sorting in various cellular compartment regarding to its functions.
CO3: This will give the knowledge of cellular signaling pathways and signal transduction pathways which are very helpful to understand the cellular processes
CO4: It will explain student about different phases of cell cycles and their regulation which will help them to understand the importance of regulation of various phases of cell cycle in cancer development.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: CELL STRUCTURE AND FUNCTIONS:
Visualizing, Transmembrane Transport of ions and small molecules

UNIT-2: CELL TRAFFICKING:
Moving Proteins in to membranes and organelles, Vesicular Traffic, secretion, and Endocytosis

UNIT-3: CELL SIGNALING:
Signaling Molecules and their Receptors, Function of cell surface Receptors, Pathways of Intracellular Signal Transduction, signal transduction and the cytoskeleton, Signaling Networks.</td></tr>
</table>

	UNIT-4: REGULATION OF EUKARYOTIC CELL CYCLE: The Eukaryotic Cell Cycle, Regulators of Cell Cycle Progression, The Events of M Phase, Meiosis and fertilization.
Reference Books	• Lodish, H. F., Berk, A. *et. al.* (2021) Molecular Cell Biology (9^{th} Ed.), W. H. Freeman and Company, New York. • Cooper, G. M., & Hausman, R. E. (2013). The Cell: A Molecular Approach (5^{th} Ed.) ASM Press., Washington, D. C.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-102: Plant and Animal Biotechnology

<table>
<tr><td>Course Code</td><td>BT-102</td></tr>
<tr><td>Course Title</td><td>Plant and Animal Biotechnology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>Purpose is to acquire fundamental knowledge in animal and plant biotechnology field and their applications.</td></tr>
<tr><td>Course Objective</td><td>The objective of this course is to introduce students with the advances in plant tissue culture, transformation techniques, genetic manipulation, crop improvement, animal cell culture techniques, transgenic animals and Stem cell technology</td></tr>
<tr><td>Course Outcomes</td><td>CO1: In this unit students would be acquainted with tissue culture aspects as well genetic transformation techniques.
CO2: Students would be familiarizing with strategies to perform manipulations in plants and methods to do crop improvement
CO3: Students would gain detail knowledge about animal cell culture techniques.
CO4: In this unit students would gain knowledge in applied and advanced aspects of animal cell culture.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
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<tr><td>Pre-requisite</td><td>Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: PLANT TISSUE CULTURE & TRANSFORMATION:
Introduction to plant tissue culture; Culture types; Plant regeneration; Gene structure; Regulation of gene expression; Protein targeting; Agrobacterium mediated gene transfer; Direct gene transfer methods; Basic features of vectors for plant transformation.

UNIT-2: GENETIC MANIPULATION AND CROP IMPROVEMENT:
Herbicide tolerance; Strategies for engineering herbicide tolerance (Glyphosate, Phosphinothricin); Insect resistance (Bt based); Plant-pathogen interactions; Approaches to disease resistance; Pathogen derived resistance (PDR); Stress tolerance (Water, Salt, Heat and cold); Improvement in fruit softening, ethylene biosynthesis, Golden Rice; Genetic mapping; QTL</td></tr>
</table>

	UNIT-3: ANIMAL CELL CULTURE TECHNIQUES: Brief history of animal cell culture; primary culture, criteria for subculture, subculture of cells growing in suspension and in monolayer, cell separation techniques, applications of cytotoxicity assays and cell viability assays. **UNIT-4: TRANSGENIC ANIMALS, STEM CELLS AND REGENERATIVE MEDICINE:** Applications of transgenic animal technology; transgenic manipulation of animal embryos; animal cloning-basic concept; cloning for conservation of endangered species; Stem cells and its applications, Source and isolation of stem cells, Embryonic and adult stem cells, culture and maintenance of stem cells; stem cells and therapeutics.
Reference Books	• Pörtner, R. (2007). Animal Cell Biotechnology: Methods and Protocols. Totowa, NJ: Humana Press. • Ian R. Freshney, Culture of animal cells: a manual of basic technique and specialized applications, 6th Ed., Willey Blackwell Publications. • Animal Biotechnology, M. M. Ranga, 2000. Agrobios, India. • Chawla, H. S. (2000). Introduction to Plant Biotechnology. Enfield, NH: Science. • Razdan, M. K. (2003). Introduction to Plant Tissue Culture. Enfield, NH: Science. • Slater, A., Scott, N. W. & Fowler, M. R. (2008). Plant Biotechnology: An Introduction to Genetic Engineering. Oxford: Oxford University Press.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-103: Enzyme Biotechnology

<table>
<tr><td>Course Code</td><td>BT-103</td></tr>
<tr><td>Course Title</td><td>Enzyme Biotechnology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The course aims at providing a vision towards advancement in the field of Enzyme Engineering.</td></tr>
<tr><td>Course Objective</td><td>The student will develop an approach for possible ways to extract enzyme and learn about the strategies and techniques for its effective manipulation.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students would be acquainted with basics of enzymes and enzymatic reactions. This course also gives them insight about the extraction and purification of enzymes.
CO2: This course introduces students about how to use enzymes effectively in the reaction by optimizing various parameters and checking inhibition.
CO3: Importance of this course is to make students understand about clinical importance of enzymology and role of inhibitors
CO4: This course would develop the skill of making use of enzymes to develop enzyme based chips and also how to perform structural modification in enzymes</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
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<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>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: INTRODUCTION TO ENZYMOLOGY:
Biocatalysts, Structure of Enzymes, Models for Monosubstrate reaction, Models for Biosubstrate Reactions, Monomeric and Oligomeric Enzymes, Multisubstrate Reactions, Enzyme Localization, Enzyme Assay, Purification of Enzymes from Natural Resources, Fractionation and Characterization of Proteins (Enzymes)

UNIT-2: ENZYME KINETICS AND INHIBITION:
Definition, Order of a Reaction, The Substrate Velocity Plot, The Mechanism Michaelis-Menten, The MM rate Equation, Constants in Enzymes Catalyst Reaction, Transformation of MM Plot into linear plot, Enzyme Inhibitors, Types of Enzymes Inhibition</td></tr>
</table>

	UNIT-3: CLINICAL ASPECTS OF ENZYMOLOGY: Introduction, Determination of Enzyme Activities for Clinical Diagnosis, Clinical Enzymology of Liver Diseases, Clinical Enzymology of Heart Diseases, Enzyme Activities in Serum in Diseases, Detection and Significance of Enzyme Deficiencies, Enzyme Inhibitors and Drug Design, Enzyme Immunoassay, Enzyme Therapy **UNIT-4: ENZYME TECHNOLOGY AND ENZYME ENGINEERING:** Production of Enzymes of Interest, Enzyme Reactor, Biosensors and Biochips, Enzyme Electrode, Inhibited Enzyme Electrode, ELISA, Engineered Enzymes, Design tools: Random mutagenesis, DNA shuffling and *De NOVO* engineering.
Reference Books	• T. Devasena (2015), Enzymology, Oxford University Press. • T. Palmer and P. L. Bonner, (2007), Enzyme: Biochemistry, Biotechnology and Clinical Chemistry, Woodhead Publishing Limited. • N. C. Price and L. Stevens, (2002), Fundamentals of Enzymology, Oxford University Press. • Wolfgang Aehle, (2004), Enzyme in Industry: Production and Application (Ed.) Wiley-VCH Verlag GmbH & Co. KGaA. • Branden and Tooze, (1999), Introduction to Proteins Structure, Garland Publishing Group • Gary Walsh, (2014), Proteins: Biochemistry and Biotechnology, John Wiley & Sons Ltd.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-104 Elective Paper-I: Environmental Biotechnology

<table>
<tr><td>Course Code</td><td>BT-104 Elective Paper- I</td></tr>
<tr><td>Course Title</td><td>Environmental Biotechnology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 hrs</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>Environmental Biotechnology is to use bio- based technologies in conjunction with other technologies to prevent, halt, and reverse environmental degradation while emplacing safety precautions as a fundamental component of the programme.</td></tr>
<tr><td>Course Objective</td><td>To conserve the natural resources via recycling waste materials.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will learn how to degrade pollutant dyes from effluents and solid wastes generated by different dyeing industries and also learn how to remove biodegradable material and suspended solid using various technologies.
CO2: The purpose of the study is to present a conceptual overview of Phyto technologies and their significance in relation to a variety of environmental issues and potential remedies. It does, however, provide the foundation for a conceptual framework for recognizing the value of ecosystem approaches in achieving sustainable development goals.
CO3: Students will learn about bio-indicators that are used to monitor the health of the environment and also learn about the prevention of pollution causes by the radiation.
CO4: Students will learn about genetic modifications technologies that alter the genetic makeup of living organisms such as animals, plants or bacteria and also learn about genetically modified organism (GMO) which are used for producing genetically modified foods.</td></tr>
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<tr><td>Pre-requisite</td><td>Basics Science</td></tr>
<tr><td>Course Content</td><td>UNIT-1: BIOTECHNOLOGY: FOOD, DYESTUFF AND ALLIED INDUSTRIES:
Importance of natural dyes, Problem of dyes in the effluent technologies available for removal of dyes from industrial effluents, Microbial populations associated with treatment of an industrial dye effluent, Nature of effluents from food processing industries, Biological treatment methods for food industry effluents, Basic</td></tr>
</table>

	concept of wastewater treatment process **UNIT-2: PHYTOTECHNOLOGY:** Phytoremediation Approaches, Types of Phytoremediation, Factors Affecting to Phytoremediation, Cellular Mechanism for Heavy Metals Detoxifications and Tolerance, Phytoremediation-Using Plants to clean up Polluted Soil **UNIT-3: ENVIRONMENTAL POLLUTION: RADIATION, BIOINDICATORS AND BIOLOGICAL MARKERS:** Radiation Pollution and Radioactivity, Radiation Pollution Prevention: A Cash Study of Environment and Heritage Service, Bio-indicators: Uses and Types, Biological Markers: Their use in Quantitative Assessments **UNIT-4: GENETICALLY MODIFIED ORGANISMS IN ENVIRONMENT:** Genetic Modification – Perspective, Genetic Modified Products – Benefits, Genetic Modified Foods, Ecological and Environmental Impact of Engineered Crops, Environmental Impact of Transgenic Crops – Case Studies, GMO Risk and Regulations
Reference Books	• S. N. Jogdand (2006), Environmental Biotechnology (Industrial Pollution Management), Himalaya Publishing House. • R. Marandi and A. Shaeri (2009), Environmental Biotechnology, SBS Publishers & Distributors Pvt Ltd, New Delhi. • M. H. Fulekar (2010), Environmental Biotechnology, Science Publishers. • G. M. Evans and J. C. Furlong (2003), Environmental Biotechnology: Theory and Applications, Wiley Publishers. • Metcalf & Eddy (2014) Wastewater Engineering Treatment and Resource Recovery, McGrow Hill, Fifth Edition.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-104 Elective Paper-II: Advances in Nanobiotechnology

<table>
<tr><td>Course Code</td><td>BT-104 Elective Paper-II</td></tr>
<tr><td>Course Title</td><td>Advances in Nanobiotechnology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The course aims at providing a vision towards advancement in the multi-disciplinary field of -Nanobiotechnology.</td></tr>
<tr><td>Course Objective</td><td>The student will gain awareness regarding the possibilities of application, challenges and limitations in the field of nanobiotechnology.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: The unit will give a brief idea of major components and application of nanotechnology that are applicable in biological field.
CO2: Students will get to know the structural stability and factors affecting the biomolecules as bio-nano-machinery
CO3: The unit explains the functional aspects of biological systems that may affect the feasibility and application of nanoparticles in the biological world.
CO4:The toxicity of nanoparticles in biological as well as under the environmental conditions will be introduced in this unit</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: COMPONENTS AND APPLICATIONS OF NANOBIOTECHNOLOGY:
Introduction to Cellular Nanostructures; Nanopores; Biomolecular motors; Nanoparticles for drug delivery, Nanomedicine for neurodegenerative diseases, Therapeutic application of ligand-targeted NPs, Nanoparticles for diagnostics and imaging (Theranostics) concepts, Nano devices for biosensor, Bio-plotter and 3D printer in Bio-nanotechnology

UNIT-2: STRUCTURAL PRINCIPLES:
Structural aspects of biomolecules as bio-nano-machinery; Forces responsible for structural stability of biomolecules (covalent, hydrogen bonds, electrostatic, hydrophobic). Hierarchical self-assembled Nano-structures, self-organisation (Lipid bilayer); membrane, enzyme flexibility as challenge in structural design of nanoparticles.</td></tr>
</table>

	UNIT-3: FUNCTIONAL PRINCIPLES: Concepts of smart stimuli responsive nanoparticles, strategies for cellular internalization and long circulation, strategies for enhanced permeation through various anatomical barriers, Nanomaterials use as implants: biological response; nanocomposite scaffolds – bioactive scaffolds – scaffolds for stem cells, Medical Nanorobots **UNIT-4: NANO-TOXICITY:** Introduction to Safety of nanomaterials, Basics of Nano toxicity, Models and assays for Nano toxicity assessment; Mechanism of Nano size particle toxicity -Passage through biological membranes-toxicokinetics Fate of nanomaterials in different strata of environment that affect the human population; Regulations and permissible limits.
Reference Books	• Young-Chul Lee, Ju-Young Moon (2020) Introduction to Bio-nanotechnology, Springer • Madhuri Sharon, Maheshwar Sharon, Sunil Pandey, Goldie Oza, (2012), Bio-Nanotechnology: Concepts and Applications; Ane Books. Pvt. Ltd. • David S. Goodsell, (2004); Bio-nanotechnology: Lessons from Nature; Wiley-Liss • Neelina H. Malsch (2005), Biomedical Nanotechnology, CRC Press • Greg T. Hermanson, (2013); Bioconjugate Techniques, (3rd Edition); Elsevier
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-105: Practical

<table>
<tr><td colspan="2">Course Code</td><td>BT-105</td></tr>
<tr><td colspan="2">Course Title</td><td>Practical</td></tr>
<tr><td colspan="2">Credit</td><td>12</td></tr>
<tr><td colspan="2">Teaching per week</td><td>4 h X 3 days = 12 h</td></tr>
<tr><td colspan="2">Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td colspan="2">Effective from</td><td>2022-2023</td></tr>
<tr><td colspan="2">Purpose of Course</td><td>The set of experiments will give students direct exposure of practical knowledge in the field of Cell culture, Enzyme engineering, Nanobiotechnology and Environmental Biotechnology</td></tr>
<tr><td colspan="2">Course Objective</td><td>The give students an hands on experience and learn how to plan, execute and draw inference from the practical’s</td></tr>
<tr><td colspan="2">Course Outcomes</td><td><u>Core Papers:</u> CO1 to CO12: By performing the set of experiments students will learn suspension culture, banding and karyotype preparation, cell counting and viability. They will be acquainted with animal cell culture maintenance, Geno-toxicity, plant tissue culture and phytochemical analysis. They will have hands on to perform experiments related to enzyme activity, kinetics, immobilisation and extraction.
<u>Elective Paper-I:</u> CO13 to C16: Students will learn to perform experiments related to testing different parameters of wastewater, heavy metal concentration and industrial visit.
<u>Elective Paper-II:</u> CO17 to C20: The students will be familiarised with Nano-biotechnology practical such as synthesis, characterisation and application.</td></tr>
<tr><td colspan="2">Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO 1-12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO 13-16</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO 17-20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td colspan="2">Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>BT-101
Core Paper I:
Advances in Cell Biology

BT-102
Core Paper II:</td><td>1. To perform suspension culture (PBLC) and prepare metaphase plate.
2. To perform GTG banding and preparation of Karyotype from metaphase plates.
3. Isolation of peripheral blood mononuclear cells (PBMC).
4. Cell counting and viability.

5. Cell culture: cell revival and its maintenance.
6. To perform Geno-toxicity by micronucleus assay.</td></tr>
</table>

	Plant and Animal Biotechnology **BT-103** **Core Paper III:** Enzyme Biotechnology **BT-104** **Elective Paper-I** Environmental Biotechnology **BT-104** **Elective Paper-II** Advances in Nanobiotechnology	7. Preparation of plant tissue culture media for *in vitro* regeneration of anthers. 8. Qualitative and quantitative estimation of phytochemicals. 9. Determination of optimum reaction conditions for enzyme activity. 10. Enzyme kinetics Michaelis-Menten parameters (substrate concentration). 11. Immobilisation of whole cells (Yeast/Bacteria) by calcium alginate method. 12. Extraction of enzyme from plant source and assay of enzyme activity. 13. To determine the amount of dissolved oxygen in wastewater by iodometric titration method 14. To determine BOD/ COD/ TSS/ TOC/ Sulphate/ pH/ TKN/ Colour/ TDS of a given wastewater sample. 15. To determine the concentration of hexavalent chromium in the give wastewater sample. 16. Visit of industrial and domestic wastewater treatment plant. 17. Synthesis of nanoparticles 18. Characterisation of synthesised Nanoparticles 19. To check anti-microbial activity of synthesised nanoparticles 20. Study of Nano-formulations using herbal extract
Reference Books		• T. B. Jha and B. Ghosh, (2007); Plant tissue culture basic and applied; Universities press • O. L. Gamborg and G.C. Phillips (2005), Plant cell tissue and organ culture: Fundamental methods, NAROSA publishing house • T. Devasena, (2010); Enzymology; OXFORD University Press • R. I. Freshney (2015); Culture of Animal Cells: A manual of basic technique and specialized applications. John Wiley & Sons. • R. S. Sengar, S. Gupta and A. K. Sharma (2011); Laboratory manual on Biotechnology; Studium Press, New Delhi.
Teaching Methodology		Laboratory work, Journal preparation
Evaluation Method		30% Internal assessment based on class attendance, participation, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VII

Course: BT-106: Techniques for Genetic Testing and Sequencing

<table>
<tr><td>Course Code</td><td>BT-106</td></tr>
<tr><td>Course Title</td><td>Techniques for Genetic Testing and Sequencing</td></tr>
<tr><td>Credit</td><td>2</td></tr>
<tr><td>Teaching per week</td><td>2 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of this course is to familiarize students in Human Genetics and Genetic Counselling with genetic techniques “hands-on” using a variety of genetic techniques with a clinical perspective. These genetics techniques are applied to problems in human genetics, such as diagnosis, determining prognosis, family studies and mutation analysis; and used to determination test results, interpretation and reporting findings.</td></tr>
<tr><td>Course Objective</td><td>Students will participate in laboratory exercises to become acquainted with cytogenetics laboratory procedures including cell culture, chromosome preparation, chromosome banding, and karyotyping.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Upon completion, students will understand the concepts of classical cytogenetic methods including various cell culture methods and chromosomal banding techniques.
CO2: Students will be able to locate the specific DNA sequences, diagnosis of genetic diseases, gene mapping, and identification of novel oncogenes or genetic aberrations contributing to various types of cancers.
CO3: The students will be able to learn the techniques used for pre-natal genetic testing which will be applied for reproductive health.
CO4: Students will understand basics of various sequencing methods and their applications.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology and Genetics</td></tr>
<tr><td>Course Content</td><td>UNIT-1: TECHNIQUES IN CLASSICAL CYTOGENETICS
Peripheral Blood Karyotype, Bone Marrow Karyotype, Different banding techniques (G, Q, C and R Banding)

UNIT-2: ADVANCED TECHNIQUES IN CYTOGENETICS
Fluorescent In Situ Hybridisation (FISH), Multiplex In Situ Hybridisation (M-FISH), COmbined Binary RAtio- Fluorescent In Situ Hybridisation (COBRA-FISH), Quantitative Fluorescent In</td></tr>
</table>

	Situ Hybridisation (Q-FISH), Spectral Karyotyping (SKY), Comparative Genomic Hybridisation (CGH) **UNIT-3: SEQUENCING TECHNOLOGY** Sequencing Approaches, Polymerase Chain Reaction (PCR), Sanger Sequencing, Sequencing by synthesis, ((Next-Generation Sequencing (NGS), Single Nucleotide Polymorphisms (SNP), Quantitative Reverse Transcription Polymerase Chain Reaction (QT-PCR)) **UNIT-4: GENETIC TESTING USED FOR REPRODUCTIVE HEALTH** Preimplantation Genetic Testing for Aneuploidy (PGT-A), Preimplantation Genetic Testing for Monogenic disorders (PGT-M), Advanced Comprehensive Chromosome Screening.
Reference Books	• Purandare H., Chakravarty A. (2000), Human Cytogenetic Techniques and Clinical Applications. • Russell P.J. (2010), iGenetics- A Molecular Approach, 3rd Edition. • Recent reviews papers and journal articles
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

[Academic Year of Implementation: 2022-2023]

Teaching and Examination Scheme for Semester- VIII

Course code	Paper	Teaching Schedule Hours/Week	Exam Schedule			Total Theory/Practical (Marks)	Credits
			Duration (Hours)	Internal Marks	External Marks		
	Theory papers:						
BT-201	**Core Paper I:** Genomics and Proteomics	4	3	30	70	100	4
BT-202	**Core Paper II:** Advance of Bioinformatics	4	3	30	70	100	4
BT-203	**Core Paper III:** Creativity, Innovation and Biotechnology Entrepreneurship	4	3	30	70	100	4
BT-204 BT-204	**Elective Paper-I** Aquaculture Technology **Elective Paper-II** Advances in Instrumentation and Techniques	4	3	30	70	100	4
	Practical:						
BT- 205	**Practical** based on 101 to 104	12	4 h X 3 days = 12 h	50	100	150	6
BT- 206	**Skill Based Elective Paper:** Introduction to Toxicology/ SWAYAM/MOOC courses	2	2	20	30	50	2
	Total			190	410	600	24

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT-201: Genomics and Proteomics

<table>
<tr><td>Course Code</td><td>BT-201</td></tr>
<tr><td>Course Title</td><td>Genomics and Proteomics</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>To understand the application of information obtained with different aspects like structural, functional and comparative studies of genes and proteins.</td></tr>
<tr><td>Course Objective</td><td>Objective of present course is to provide students with recent advances in new field of OMINCS. Genomics and Proteomics is application of information of different genes and proteins using sophisticated techniques like next generation sequencing and Mass Spectroscopy.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Be able to understand how to prepare maps using molecular markers Get acquainted with new sequencing techniques and platforms available for study Case study to understand the success of different projects in the field of Genomics
CO2: Able to understand the structure and organization of complexity of genome, necessary for finding the location of gene. To know the function of genes and recent technologies available for study genes in detail.
CO3: Students would be acquainted with basic of protein structure, interactions and separation technologies.
CO4: Advanced proteomic techniques and application of information in metabolomics is explored.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: MAPPING AND SEQUENCING GENOMES:
Genetic Mapping through RFLP, SSLP & SNPs; Physical mapping by Restriction and STS; Next Generation Sequencing; NGS Platforms (SOLiD, IonTorrent, Illumina, Nanopore); Human Genome Project; Human HapMap project.</td></tr>
</table>

	UNIT-2: GENOME ANNOTATION AND TRANSCRIPTOME: Annotation by analysis of gene transcripts; Genomewide RNA mapping; Components of transcriptome; Synthesis of components; Degradation of components; Influence of RNA processing; Transcriptomes in research. **UNIT-3: PROTEOMICS-I:** Introduction to protein structure and function (Binding with other molecules, Binding interface, Binding strength); Studying the composition of proteome (2D gel electrophoresis, RPLC, Ion exchange chromatography, MALDI-TOF, Protein arrays). **UNIT-4: PROTEOMICS-II:** Protein-protein interactions (Phage display, yeast two-hybrid system); Synthesis and degradation of components of proteome; Influence of protein processing; Proteomes in research (Metabolome).
Reference Books	• S. B. Primrose and R. M. Twyman - Principles of Genome Analysis and Genomics, 7 th 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, Sixth Edition, WILEY
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based onsemester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT- 202: Advances in Bioinformatics

<table>
<tr><td>Course Code</td><td>BT-202</td></tr>
<tr><td>Course Title</td><td>Advances in Bioinformatics</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>This course will give students an advance information to the various techniques of Bioinformatics. The students will become familiar with the use of a wide variety of internet applications using various tools used for phylogenetic analysis, protein prediction and drug design and will be able to apply these methods in future studies and research work.</td></tr>
<tr><td>Course Objective</td><td>The objective of this course is to provide students with theory and practical experience of use of common computational tools and databases which are used to investigate molecular and evolution concepts</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students should be able to develop an understanding of basic theory of computational tools which are used in viewing 3D structures.
CO2: Students will learn about construction of various phylogenetic trees by distance and cladistic methods and also learn how to perform cladogram/dendogram from various computational tools.
CO3: Students will learn about various tools and techniques for prediction of protein structures and also learn about different online tools for protein structure modelling.
CO4: Students will learn about various tools and techniques for drug discovery and also learn about quantitative structure activity relationship study and toxicity prediction.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: BIOLOGICAL DATABASES:
Introduction; Primary and Secondary databases; Structural Databases – PDB, MMDB, SCOP, CATH; Types of file formats; Tools for 3D structure viewers; Sequence collection, annotation and description.</td></tr>
</table>

	UNIT-2: MOLECULAR PHYLOGENY: Phenotypic & Molecular Phylogeny, Mechanism of Molecular Phylogeny, Representation of Phylogeny, Molecular Clocks; Methods of Phylogeny (Cladistic methods – Maximum parsimony, Maximum Likelihood; Distance Method - UPGMA, NJ and Fitch Margoliash method; Validation methods (Bootstrap)); Tools for Phylogenetic analysis. **UNIT-3: PROTEIN STRUCTURE PREDICTION & MODELLING:** Methods for Secondary structure prediction: Chou Fasman and GOR; Protein structures evaluation (Procheck); Software for Secondary structure prediction.; Protein Modelling: Methods of Protein Modelling, Homology Modelling, Threading or fold recognition and Ab-initio structure prediction methods.; Tools for Protein structure prediction (Predict Protein); Tools for protein structure modelling – Swiss Model. **UNIT-4: APPLICATION IN DRUG DESIGN:** Chemical databases like NCI / PUBCHEM; Fundamentals of Receptor-ligand interactions; Structure – based drug design; Ligand – based drug design; Identification and Analysis of Binding sites; QSARs study; *In silico* predictions of drug activity and ADMET
Reference Books	• S. C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition "Bioinformatics: Concepts, Skill & Applications", CBS publisher & Distributor, 2009. • Mount, D.W., "Bioinformatics: Sequence and Genome analysis", Cold Spring Harbour Laboratory Press, 2001. • Zhumur Gosh and Bibekanand Mallick "Bioinformatics: Principle and Application", Oxford University Press, 2008. • Simminder Kaur Thukral and Orpita Bosu, Pap/Cdr edition, "Bioinformatics: Database, Tools and Algorithms", Oxford University Press, USA, 2007. • N. J. Chikhale and V.S. Gomase, 1st Edition, "Bioinformatics: Theory & Practices", Himalaya Publishing House Limited, 2007. • Lesk, A. K., "Introduction to Bioinformatics" 4th Edition, Oxford University Press, 2013.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based onsemester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT-203: Creativity, Innovation and Biotechnology Entrepreneurship

<table>
<tr><td>Course Code</td><td>BT-203</td></tr>
<tr><td>Course Title</td><td>Creativity, Innovation & Biotechnology Entrepreneurship</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of this course is to make students aware with importance of creativity and innovation leading to entrepreneurship especially in field of biotechnology</td></tr>
<tr><td>Course Objective</td><td>Creativity is one foundation of successful businesses. Organizations need employees who are creative thinkers and can thrive in an organizational climate that fosters innovation. This course focuses on creativity and innovation as well as entrepreneurship in biotechnology for creating awareness among students regarding bio-business opportunities and evaluating ideas for new products, services, and the business models to execute these ideas. Using a variety of examples, discussions and exercises, students will explore and apply the principles of creativity and innovation in future considering entrepreneurship as career goal.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will be able to think out of box after learning which may lead to development of his/her ability to be creative and innovative.
CO2: This unit will open many avenues and opportunities for students to ponder upon regarding entrepreneurship in biotechnology/biological sciences.
CO3: Science student will be more confident regarding importance of finance and tools for financial analysis which shall be useful during his/her journey of entrepreneurship.
CO4: Student will be competent enough to execute effective marketing strategy and setting up SSI.</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>
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</td></tr>
<tr><td>Pre-requisite</td><td>Fundamental understanding regarding applications in Biological Sciences</td></tr>
<tr><td>Course Content</td><td>UNIT-1: CREATIVITY & INNOVATION:
1.1 Creativity: Defining Creativity: Graham Wallas Model, Systems Model & Componential Model; Key theories of Creativity: 1. Who is Creative: 2. How & Why are we creative? What is Creative? Neuroscience of Creativity; Failure and Creativity, Design thinking.</td></tr>
</table>

	1.2 Innovation: What is innovation? Innovating legacy mind-sets, innovating to take on giants, innovating to understand markets. Understanding six principles: 1. Seek Opportunity in Adversity 2. Do More with Less 3. Think and Act Flexibly 4. Keep it Simple 5. Include the Margin 6. Follow your Heart. **UNIT-2: BIOTECHNOLOGY ENTREPRENEURSHIP:** **2.1 Introduction:** Significance of the Biotechnology Entrepreneur, Integration of two distinctly different disciplines: Science & Business, Biotechnology entrepreneurship versus general entrepreneurship, Essential biotechnology versus entrepreneurial characteristics, Backgrounds of biotechnology entrepreneurs, Driving forces in decision making and learning from failure. **2.2 Fuel, Feed and Heal the world through Biotechnology Entrepreneurship**: Industrial and Environmental Biotechnology, Food and Agricultural Biotechnology, Health Biotechnology. Scheme of Assistance for Biotech Industry: Biotechnology Policy (2022-2027) in Gujarat. **UNIT-3: FINANCE:** **3.1 Finance:** Source of development finance, Institutional financing to Entrepreneurs, Difference between Proprietorship, Pvt. Ltd, Ltd., LLP. company, Taxation, Role of consultancy organizations. **3.2 Financial Analysis:** Ratio analysis, Break even analysis, Profitability analysis, Budget and planning process. **UNIT-4: MARKETING:** **4.1 Marketing Channels:** Methods of marketing, Marketing channels, Introduction to E-commerce and E-business: Features of E-commerce technology; Business models of E-commerce; Advantages and Disadvantages of E-commerce in E-business. **4.2 Setting up a Small Scale Industry:** Location of an enterprise, Steps for starting a Small Industry, Incentives and Subsidies. Government policies for new venture, MSME.
Reference Books	• Biotechnology Entrepreneurship (2014) Craig Shimasaki, Academic Press, USA. • Dynamics of Entrepreneurial Development and Management (2005) Vasant Desai, Himalaya Publishing House. • Making Breakthrough Innovation Happen: How Eleven Indians Pulled of the Impossible (2009) Porus Mushi, Harper Collins Publishers India. • The CII Entrepreneur Hand Book: Practical Advice for Starting a New Business (2010) Sushila Ravindranath, Westland Ltd. • The Game Changers: 20 extraordinary success stories of Entrepreneurs (2013) Y. Modi, R. Kumar & A. Kothari, Random House Publishers India Pvt. Ltd.

	• Creativity and Innovation: Theory, Research and Practice 2nd Edition (2022) Jonathan A. Plucker, Routledge (Taylor & Francis Group), New York. • E-Commerce for Entrepreneurs (2021) Sudeshna Chakraborty & Priyanka Tyagi, BPB Publications, India.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based onsemester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT-204 Elective Paper – I: Aquaculture Technology

<table>
<tr><td>Course Code</td><td>BT-104 Elective Paper-I</td></tr>
<tr><td>Course Title</td><td>Aquaculture Technology</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>Students should be able to gain fundamental knowledge in aquaculture technology and its applications.</td></tr>
<tr><td>Course Objective</td><td>The objectives of this course are to introduce students to the principles, practices and application of aquaculture technology, aqua feed and diseases, algal and aquaculture biotechnology.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: To develop competence in the area of aquaculture technology.
CO2: To have a comprehensive understanding of aqua feed and diseases of fishes
CO3: To Understand the processes and protocols related to chromosome manipulations and transgenic technology and biotechnological applications.
CO4: To understand the concepts of algal biotechnology.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: INTRODUCTION TO AQUACULTURE:
Concept of Blue Revolution – Definition and Scope of Aquaculture, General characters of fishes, crustaceans and molluscs, Fishery management and conservation, Bio security in aquaculture.

UNIT-2: AQUA FEED and DISEASES:
Feed technology and Probiotics.
Bacterial, Viral and Fungal diseases of fishes and their diagnosis, Fish spoilage and marine toxins, Bio-fouling.

UNIT-3: AQUACULTURE BIOTECHNOLOGY:
Transgenic fish production, Chromosomal Manipulation-Ploidy manipulation, Androgenesis and Gynogenesis, Fish vaccines and its development, Applications of recombinant hormones and growth factors in aquaculture.</td></tr>
</table>

	UNIT-4: ALGAL BIOTECHNOLOGY: A general account of algae**,** Economic importance of seaweeds and algae**,** Bioactive compounds from marine organisms**,** Seaweed and microalgae culture methods.
Reference Books	• Malvee, S. (2008). Fish Genetics, SBS-Publishers, New Delhi • Selvamani, B. R. and Mahadevan, R. K. (2008). Fish health and diseases, Campus Book Internationals, New Delhi. • Sundarary, J. K. *et. al.* (2018). Frontiers in Aquaculture, Narendra Publishing House, Delhi • Khanna, S. S. and Singh, H.R. (2015). A Text book of Fish Biology and Fisheries 3rd Edition, Narendra Publishing House, Delhi • Mehta, V. (2006). Encyclopaedia of Biotechnology, Campus Book Internationals, New Delhi. • Jadhav, U. (2009). Aquaculture technology and Environment, PHI Learning Private Limited, New Delhi.
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based onsemester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT-204 Elective Paper – II: Advances in Instrumentation and Techniques

<table>
<tr><td>Course Code</td><td>BT-204 Elective Paper-II</td></tr>
<tr><td>Course Title</td><td>Advances in Instrumentation and Techniques</td></tr>
<tr><td>Credit</td><td>4</td></tr>
<tr><td>Teaching per Week</td><td>4 h</td></tr>
<tr><td>Minimum weeks per Semester</td><td>15 (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective From</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The purpose is to make students aware with basic and advanced techniques and instruments used in Biotechnology field</td></tr>
<tr><td>Course Objective</td><td>The objectives of this course are to sensitize the students to know about the basic and advanced instrumentation and techniques which will be helpful in their research and academics</td></tr>
<tr><td>Course Outcomes</td><td>CO1: to give basic knowledge of spectroscopy and advanced type of microscopy
CO2: this will give the knowledge of electrophoresis techniques used for protein and nucleic acid purification
CO3: it will explain student about different types of advanced separation techniques
CO4:it will explain students how to use combination of advanced techniques with high throughput instruments for their further applications in research and academia</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td><td>PSO8</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: Advances in Spectroscopy:
Principle, Instrumentation, interpretation of results in IR spectroscopy, FT-IR principle and application, working principle of NMR, Mass spectrometry and their application CD spectroscopy X-ray diffraction/Crystallography principle and applications.

UNIT-2: Electrophoresis Techniques:
SDS-PAGE, Native gels and gradient gels, IEF, Blotting techniques, PFGE, DGGE, TGGE, Microarray</td></tr>
</table>

	UNIT-3: GC and HPTLC: HPTLC methods of development and spot detection, GC-principle, stationary and mobile phases, Detectors-FID, TCD, ECD, GC-MS combinations, Limitations of GC **UNIT-4: Advances in Liquid Chromatography:** HPLC-components of instrumentation, isocratic, binary and quaternary system, types of column, stationary and mobile phases, detectors- U.V. absorption, PDA, RI and fluorescence, LC-MS, FPLC
Reference Books	• Skoog D. Skoog and west's Fundamentals of analytical chemistry, Andover: Cengage learning EMEA:2014 • Keith Wilson & John walker (ED) (2000): Practical Biochemistry-principle &Techniques. Cambridge University Press
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based onsemester end University examination

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT-205: Practical

<table>
<tr><td>Course Code</td><td colspan="2">BT-205</td></tr>
<tr><td>Course Title</td><td colspan="2">Practicals</td></tr>
<tr><td>Credit</td><td colspan="2">12</td></tr>
<tr><td>Teaching per week</td><td colspan="2">4 h X 3 days = 12 h</td></tr>
<tr><td>Minimum weeks per semester</td><td colspan="2">15 weeks (Including Classwork, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td colspan="2">2022-2023</td></tr>
<tr><td>Purpose of Course</td><td colspan="2">The set of experiments will give students direct exposure of practical knowledge in the field of Cell culture, Enzyme engineering, Nanobiotechnology and Environmental Biotechnology</td></tr>
<tr><td>Course Objective</td><td colspan="2">The give students an hands on experience and learn how to plan, execute and draw inference from the practical’s</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">Core Paper: CO1 to CO12: By performing the set of experiments students will learn chromosomal DNA isolation, restriction digestion mapping, plant DNA isolation, separation of protein using SDS-PAGE, different protein structure modelling and homology modelling. In activity based practical learning tasks, development of entrepreneurial skills is expected outcome.
Elective Paper–I: CO13 to CO16: The students will be able to microbial analysis of fishes, detection of virus in shrimp and study commercially important fishes, seaweeds and algae
Elective Paper–II: CO17 to CO20: The students will have hands on different analytical instruments like FTIR, HPLC, NMR and GC.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td colspan="2">
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th><th>PSO8</th></tr>
<tr><td>CO 1-12</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO 13-16</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO 17-20</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td colspan="2">Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td>Course Content</td><td>BT- 201
Core Paper I:
Genomics and Proteomics

BT- 202
Core Paper II:</td><td>1. Isolation of Chromosomal DNA from Saccharomyces cerevisiae/Aspergillus niger
2. To perform the restriction digestion mapping of DNA
3. Total protein isolation from plants
4. SDS-PAGE separation of proteins

5. Use of different protein structure databases – PDB, MMDB, SCOP, CATH</td></tr>
</table>

	Advance of Bioinformatics	6. Construction and study of protein structures using Deep view / Pymol / RASMOL 7. Creation of Cladogram / Phylogram using NJ and UPGMA method 8. Perform homology modelling using Swiss model/ Analysis of Binding Site of Protein/ Evaluation of predicted structure by Procheck and Ramachandran Plot
	BT-203 **Core Paper III:** Creativity, Innovation and Biotechnology Entrepreneurship	9. The General measure of Enterprising Tendency (GET) test. 10. Team Task-01: Fixing interview with entrepreneur (preferably Alumni of department) 11. Team Task-02: Seeking detailed information (education, experience, how much he/she initially invested, profit margin, monthly sale, difficulties etc.) from any vendor/community helper/food vendor/Road side trader. 12. Investigation of Advertisement
	BT-204 **Elective Paper-I** Aquaculture Technology	13. To study commercially important fishes, freshwater algae and seaweeds. 14. Microbial analysis for fish/prawn. 15. Detection of White Spot Syndrome Virus in shrimps by PCR technique (Demonstration). 16. Review Article on any recent/emerging areas of aquaculture (OR) Field visit to any one place-Processing Unit (Fish/Prawn), Culture Farm (Fish/Prawn), Fisheries /aquaculture Educational/Research institute.
	BT-204 **Elective Paper-II** Advances in Instrumentation and Techniques	17. Demonstration /visit of laboratory for study of instruments FT-IR 18. Demonstration /visit of laboratory for study of instruments NMR 19. Demonstration /visit of laboratory for study of instruments HPLC & HPTLC 20. Demonstration /visit of laboratory for study of instruments GC
Reference Books	• T. A. Brown – Genomes IV, Garland Science, Taylor & Francis Group. • S.C. Rastogi, N. Mendiratta and P. Rastogi, 2nd Edition "Bioinformatics: Concepts, Skill & Applications", CBS publisher & Distributor, 2009. • Keith Wilson & John walker (ED) (2000): Practical Biochemistry-principle &Techniques. Cambridge University Press	
Teaching Methodology	Laboratory work, Journal preparation	
Evaluation Method	30% Internal assessment based on class attendance, participation, internal examination, etc. 70% External based on semester end University examination	

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
M. Sc. Integrated Biotechnology Semester-VIII

Course: BT-206: Introduction to Toxicology

<table>
<tr><td>Course Code</td><td>BT-206</td></tr>
<tr><td>Course Title</td><td>Introduction to Toxicology</td></tr>
<tr><td>Credit</td><td>2</td></tr>
<tr><td>Teaching per week</td><td>2 h</td></tr>
<tr><td>Minimum weeks per semester</td><td>15 weeks (Including Class work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2022-2023</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of this course is to familiarize students in toxicology</td></tr>
<tr><td>Course Objective</td><td>To understand the type and nature of toxicants
To understand mechanism of toxicant actions on living organism</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Upon completion, students will understand the concepts of Be able to describe the composition and functional toxicology principles.
CO2: Students will be able to understand the action of toxic compounds
CO3: The students will be able to learn the general mechanism of action and clearance of toxic compound
CO4: Students will be able to formulate the test required for testing toxicity.</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
<table>
<tr><th></th><th>PSO 1</th><th>PSO 2</th><th>PSO 3</th><th>PSO 4</th><th>PSO 5</th><th>PSO 6</th><th>PSO 7</th><th>PSO 8</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: INTRODUCTION TO TOXICOLOGY:
Definition and Scope, Source/Classification of Toxic compounds (Exposure in environmental and occupational setups, and adulterations; Use: heavy metals, agrochemicals, food additives, drugs and chemicals, cosmetics with one example for each)

UNIT-2: TOXIC ACTION:
Dose-Response Relationship, biological interactions, mechanism(s) of action (commonly used toxicants) and Metabolism of Toxicants

UNIT-3: MECHANISM AND CLEARANCE:
Mechanism(s) of Toxicity (systemic and Hepatotoxicity and Nephrotoxicity), Toxicokinetics (Classic: One-Compartment and Two-Compartment model and Relationship of Elimination Half-life to Clearance)</td></tr>
</table>

	UNIT-4: TOXICITY TESTING: *In Vivo* Tests: Acute, Sub-acute, Subchronic, Chronic and carcinogenicity, and genotoxicity. *In vitro* tests: Prokaryote Mutagenicity -Ames Test, Eukaryote Mutagenicity -Drosophila Sex - Linked Recessive Lethal Test, Health risk assessment analysis: Identification, characterization, impact analysis of hazard, and communication of health risk.
Reference Books	• Hodgson E., (2010) A textbook of Modern Toxicology, John Wiley & Sons INC., Publication (Fourth edition). • Klaassen C.D., (2008) Casareett and Doull's Toxicology: The basic Science of Poisons, McGraw-Hill Publishing division Chicago (Seventh Edition) • Pandey K., Shukla J. P., and Trivedi S. P., (2009) Fundamental of Toxicology, New Central Book Agency New Delhi • Recent reviews papers and journal articles
Teaching Methodology	Classwork, Discussion, Self-Study, Seminars and/or Assignment
Evaluation Method	30% Internal assessment based on class attendance, participation, class test, quiz, assignment, seminar, internal examination, etc. 70% External based on semester end University examination