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

ક્રમાંક :એસ./પરિપત્ર/૧૫૯૯૩/૨૦૨૩
તા.૨૬/૦૬/૨૦૨૩

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

વિષયઃ– એમ.એસસી.બાયોટેકનોલોજી વિષયનાં સેમેસ્ટર–૯ અને ૧૦ ના અભ્યાસક્રમ બાબત.

સુજ્ઞશ્રી,

સવિનય જણાવવાનું કે, શૈક્ષણિક વર્ષ–૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc. Biotechnology Semester- 9 & 10 ના અભ્યાસક્રમ સંદર્ભે બાયોટેકનોલોજી વિષયની(નિયુકત) એડહોક અભ્યાસ સમિતિની તા.૨૩/૦૫/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ સ્વીકારી વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ૭ અન્વયે કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૨૩/૬/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ૨૯ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

<u>બાયોટેકનોલોજી વિષયની(નિયુકત) એડહોક સમિતિની તા.૨૩/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૨</u>

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ–૨૦૨૩–૨૪ થી અમલમાં આવનાર એમ.એસસી. બાયોટેકનોલોજી સેમેસ્ટર– IX અને X ના અભ્યાસક્રમમાં સુધારા વધારા કરી સર્વાનુમતે મંજૂર કરી તે મંજૂર કરવા વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંકઃ૭

:: આથી ઠરાવવામાં આવે છે કે, બાયોટેકનોલોજી વિષયની (નિયુકત) એડહોક સમિતિની તા.૨૩/૦૫/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૨ અન્વયે કરેલ ભલામણ સ્વીકારી શૈક્ષણિક વર્ષ–૨૦૨૩–૨૪ થી અમલમાં આવનાર એમ.એસસી. બાયોટેકનોલોજી સેમેસ્ટર– IX અને X ના અભ્યાસક્રમમાં સુધારા વધારા કરી સર્વાનુમતે મંજૂર કરી તે મંજૂર કરવા એકેડેમિક કાઉન્સિલને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૨૩/૦૬/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ૨૯

:: આથી ઠરાવવામાં આવે છે કે, વિજ્ઞાન વિદ્યાશાખાની તા.૧૯/૦૬/૨૦૨૩ ની સભાની ઠરાવ ક્રમાંકઃ૭ અન્વયે કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

(બિડાણઃ ઉપર મુજબ)

કુલસચિવ

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

.....જાણ સારૂ.

(5) અ.નં.29 પા-19

ઠરાવ નં:- 6

એકેડેમિક કાઉન્સિલ તા.23/06-2023
આઇટમ નં.29 બિડાણ/પરિશિષ્ટ 19

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology

[Academic Year of Implementation: -2023-2024]

Teaching and Examination Scheme for Semester- IX

Course code	Paper	Teaching Schedule Hours/Week	Exam Schedule			Total Theory/Practical (Marks)	Credits
			Duration (Hours)	Internal Marks	External Marks		
	Theory papers:						
BT-301	**Core Paper I:** Advances in Molecular Biology	4	3	30	70	100	4
BT-302	**Core Paper II:** Bioprocess Technology	4	3	30	70	100	4
BT-303	**Core Paper III:** Cancer and Applications of Molecular Genetics	4	3	30	70	100	4
BT-304 BT-304	**Elective Paper-I** Industrial Biotechnology **Elective Paper-II** Research Methodology, Biostatics & IPR	4	3	30	70	100	4
	Practicals:						
BT- 305	**Practicals** based on 301 to 304	12	4 h X 3 days = 12 h	50	100	150	6
BT- 306	**Skill based elective paper:** Biological Imaging/ 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-IX

Course: BT-301: Advances in Molecular Biology

<table>
<tr><td>Course Code</td><td>BT-301</td></tr>
<tr><td>Course Title</td><td>Advances in Molecular 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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>Field of Molecular Biology has seen lot of advances and need of hour is to acquaint students about these. The purpose of this course is to familiarize the students of recent developments and applications in this field.</td></tr>
<tr><td>Course Objective</td><td>Course objective is to give detailed knowledge about recent developments in the techniques used to study DNA as well as most application of new developed techniques.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: This unit will familiarize student various ways of transcriptional regulation of gene expression
CO2: Able to know different techniques used to study nucleic acid protein interactions
CO3: Students will come to know about various epigenetic factors having role in gene regulation
CO4: Role of genome expression in cellular differentiation and development of different organisms</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>
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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>Basic of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: REGULATION OF GENE EXPRESSION
Introduction, Activators and Repressors, Chromatin Remodeling, Nucleosome Organization, Methylation, Histone Phosphorylation

UNIT-2: THE ROLE OF DNA-BINDING PROTEIN IN GENOME EXPRESSION
Introduction, Techniques, Special features, Interactions between DNA and its binding proteins.

UNIT-3: EPIGENETICS
Introduction, Heterochromatin interactions, CpG Islands, Yeast Prions, X-Chromosome, Imprinting.</td></tr>
</table>

	UNIT-4: GENE EXPRESSION IN CONTEXT OF CELL AND ORGANISM Introduction, Signal transmission, Signal transduction, Cellular differentiation, Development of organism (Bacteriophage λ, *Bacillus* sporulation, *Caenorhabditis elegans*)
Reference Books	• Krebs, Goldstein, Kilpatrick. 2018, Lewin's Genes XII, Jones & Bartlett,Ed. XII. • T.A. Brown. 2018, Genome 4, Garland Science, Taylor & Francis Group,Ed. IV. • Watson, Baker, Bell, Gann, Levine, Losick. 2013, Molecular Biology of the Gene, Cold Spring Harbor, New York, Ed. VII.
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-IX

Course: BT- 302: Bioprocess Technology

Course Code	BT-302
Course Title	**Bioprocess Technology**
Credit	4
Teaching per week	4 h
Minimum weeks per semester	15 weeks (Including Classwork, examination, preparation, holidays etc.)
Effective from	2023-2024
Purpose of Course	This course aims to provide an understanding of bioprocess technology and its application in the field of biotechnology. The course covers the fundamental principles of bioprocess technology, including cell cultivation, fermentation, downstream processing, and product purification. The course also covers some very important recent advances in bioprocessing.
Course Objective	Objectives of course is to provide basic understanding regarding the principles of bioprocess technology. Application of knowledge of bioprocess technology to design and optimize bioprocesses. Evaluation regarding feasibility of bioprocesses for different applications and regulatory requirements and finally to make student understand regarding how to analyse and interpret data from bioprocess experiments.
Course Outcomes	**CO1:** Understand the principles of bioprocess technology **CO2:** Apply knowledge of bioprocess technology to design and optimize bioprocesses. **CO3:** Student will gain knowledge regarding cell separation and product purification. They will also be able to analyse and interpret data from bioprocess experiments. **CO4:** Keep student updated regarding latest development and application of bioprocess.
Mapping between COs with PSOs	
Pre-requisite	Fundamental understanding regarding applications in Biological Sciences
Course Content	**UNIT-1: INTRODUCTION** Understanding difference between Bioprocess technology and Fermentation technology, Bioprocess development-An interdisciplinary challenge, Thermodynamic preliminaries, Law of conservation of mass, Stoichiometry of cell growth and product formation, Introduction to animal cell culture and bioreactor technology. **UNIT-2: UPSTREAM PROCESS** Production of: Single Cell Protein (SCP), Penicillin, Citric acid, Wine, Ethanol, L-lysine and Human Recombinant Insulin.

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

	UNIT-3: DOWNSTREAM PROCESS Introduction to cell separation systems, Criteria for decision, Pre-treatment's, CGMP and Regulatory considerations, Conventional filtration and Cross flow microfiltration, Centrifugation, Cell disruption methods, Product recovery trains (General Concepts), Recovery of citric acid and ethanol. **UNIT-4: RECENT ADVANCES IN BIOPROCESS TECHNOLOGY** Continuous Bio-manufacturing in Microbial Systems, Developments and opportunities in continuous biopharmaceutical manufacturing, On-demand bio-manufacturing through synthetic biology approach, CRISPR/Cas System toward the development of Next-Generation Recombinant Vaccines, Automation and Artificial Intelligence (AI) in filamentous fungi-based bioprocess, Microfluidics for cell factory and bioprocess development, Process Analytical Technologies- Advances in bioprocess integration and future perspectives.
Reference Books	• Lydersen, B. K., D'Elia, N. A. & Nelson, K. L. (2010) *Bioprocess Engineering: Systems, Equipment and Facilities.* Wiley India Pvt. Ltd. • Stanbury, P. F. & Whitaker, A. (1984) *Principles of Fermentation Technology.* Pergamon Press. • Reed G. (2004) *Prescott and Dunn's Industrial Microbiology*. CBS Publishers & Distributors • Peppler, H. J., & Perlman, D. (2012) *Microbial Technology, 2nd Edition, Vol. 1 and 2*. Academic Press Inc. • Doran, P. M. (2019) *Bioprocess Engineering Principles*, 2nd Edition, Academic Press. • https://doi.org/10.3389/fbioe.2021.665940 • https://doi.org/10.1016/j.biortech.2022.128421 • https://doi.org/10.1007/s13369-022-07266-7 • https://doi.org/10.1016/j.copbio.2018.08.011 • https://doi.org/10.1016/j.mtbio.2022.100518 • https://doi.org/10.1016/j.jpba.2021.114379 • https://doi.org/10.1080/19420862.2021.1903664
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-IX

Course: BT-303: Cancer and Applications of Molecular Genetics

<table>
<tr><td>Course Code</td><td>BT-303</td></tr>
<tr><td>Course Title</td><td>Cancer and Applications of Molecular Genetics</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 Class-work, examination, preparation, holidays etc.)</td></tr>
<tr><td>Effective from</td><td>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>The goal of this course is to introduce students to the field of cancer biology and molecular genetics applications and to train them for learning the mechanisms of cancer development and progression.</td></tr>
<tr><td>Course Objective</td><td>The course will stand on its utility towards learning and implementing the aspects towards basic and recent developments in the field of cancer biology. After completing the course, the students should have in depth understanding of the molecular and cellular mechanisms leading to cancer as well as applications of molecular genetics.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will learn the basic characteristics of Cancer cells and details of different apoptotic pathways.
CO2: Students will acquire detailed knowledge of two main groups of cancer-causing genes.
CO3: Students will be acquainted about new strategies used in the treatment of cancer.
CO4: Students will gain insights about the application of molecular genetics in identification and diagnosis of human diseases as well as its role in various other fields of 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>
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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</td></tr>
<tr><td>Course Content</td><td>UNIT-1: INTRODUCTION AND APOPTOSIS
Basic properties of cancer cells, Causes of cancer, Apoptosis (Programmed cell death), Extrinsic and Intrinsic pathways of apoptosis.

UNIT-2: GENETICS OF CANCER
Tumour suppressor genes (Role of pRB in cell cycle regulation, Role of p53 as Guardian of Genome, Role of p53 in promoting senescence, Other tumour suppressor genes, Oncogenes (Encoding growth factors or their receptors, Cytoplasmic protein kinases, Transcription factors, metabolic enzymes, State of chromatin products affecting apoptosis), MicroRNAs.</td></tr>
</table>

	UNIT-3: MOLECULAR DIAGNOSIS OF HUMAN DISEASES Molecular diagnosis of human diseases (Huntington's, Cystic fibrosis, Fragile X Syndrome), DNA profiling, Eukaryotic Protein Production-Human Growth Hormone, Reverse Genetics-Knockout mutations. **UNIT-4: NEW STRATEGIES FOR COMBATING CANCER** Immunotherapy, Inhibition of cancer-promoting proteins, Concept of cancer stem cell, Human Gene therapy, Inhibition of new blood vessels formation (Angiogenesis).
Reference Books	• Molecular Biology of the Cell by Bruce Alberts *et al.*, 5th Edition, 2008, Garland Science. • Karp's Cell Biology, Janet Iwasa and Wallace Marshall, 8th Edition, 2018, WILEY Publications. • Principles of Genetics Snustad & Simmons, 6th Edition, 2023, WILEY Publications.
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-IX

Course: BT-304 Elective Paper – I: Industrial Biotechnology

Course Code	BT-304 Elective Paper-I
Course Title	**Industrial Biotechnology**
Credit	4
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 the course is to give knowledge to the students regarding the advances in the industrial biotechnology sector.
Course Objective	The objective of the course is to sensitize the students regarding industrial products and practices that will help the students in their industrial exposure, academics and research.
Course Outcomes	**CO1**: The unit gives a glimpse about the scope and coverage of the industrial implementation of biotechnology **CO2**: The unit explains the field application biocatalyst in the industrial field and its direct implementation in the production process **CO3**: It explains the production of biotechnology related products using biobased raw material and principle of diagnostic kit. **CO4**: It creates an awareness regarding the industrial practices followed during the testing, validation and manufacturing process in a biotechnology industry.
Mapping between COs with PSOs	
Pre-requisite	Knowledge of basic Biotechnology and Bioscience
Course Content	**UNIT-1: INDUSTRIAL PRODUCTS AND BIOTECHNOLOGY** Scope and impact of Industrial Biotechnology, Sectors for implementation, History of antibiotics (Penicillin and Cephalosporin), Semisynthetic antibiotics) and fermentation (Vinegar and Lactic acid), Production Scale-up: lab to Industry **UNIT-2: INDUSTRIAL APPLICATION OF BIOCATALYST** Biocatalyst (Enzyme) [Application: Food industry (starch transformation),Dairy industry (milk clotting enzymes, cheese ripening and flavour), Baking industry, Beer- making industry: (Malting, prevention of chill haze), Fruit processing (enzymatic maceration of fruit), Probiotics and Prebiotics (Inulin and oligosaccharides), Paper and Pulp industry (Pulping,leaching, recycling and slime control)]

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

	UNIT-3: BIOBASED AND DIAGNOSTIC PRODUCTS Biofuels: Biodiesel production from Vegetable oils, Esterification process,Biopolymer production and its application (PLA and PHA), Bio surfactants, diagnostic test kits (lateral flow assay and rapid test kit) **UNIT-4: INDUSTRIAL PRACTICES** Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP) (production of Herbal, Pharmacological and Vaccines), Good Clinical Practices (GCP), Environmental impact and Process Economics, Public perception and policy development in India.
Reference Books	• Organisation for Economic Co-operation and Development (OECD). (2001). *The Application of Biotechnology to Industrial Sustainability*. • Soetaert, W., & Vandamme, E. J. (2010). *Industrial Biotechnology Sustainable Growth and Economic Success* (1st ed.). Wiley-VCH Weinheim. • World Health Organisation (WHO). (2011). *Laboratory Quality Standards and their Implementation*. • Peppler, H. J. and Perlman, D. (2012) Microbial Technology 2nd Edition, Volume-II, Academic Press, New York.
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-IX

Course: BT-304 Elective Paper – II: Research Methodology, Biostatistics and IPR

<table>
<tr><td>Course Code</td><td>BT-304 Elective Paper-II</td></tr>
<tr><td>Course Title</td><td>Research Methodology, Biostatistics and IPR</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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>The purpose of the course is to sensitize the students regarding the general methodology for research planning and advances in the field of Biostatistics.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to help students design their research studies, project proposals and analyses the results using advance bio-statistical methods.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: The unit gives a glimpse about steps for defining of research problem andtype of research design
CO2: The unit elaborates the idea of a research proposal, report and aspectsrelated to its publication.
CO3: It explains need of sampling and hypothesis testing, a statistical parameter which is considered in validation of biological studies
CO4: It explains ANOVA testing, a statistical parameter which is consideredin validation of biological studies</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>Knowledge of science and basic statistical methods</td></tr>
<tr><td>Course Content</td><td>UNIT-1: DOCUMENTS FROM RESEARCH
Qualitative and Quantitative Research, Writing of Research proposal (Type and components), Research report (Contents and format) and Research publication (Type, Selection of Journal, Formatting, Citation and Bibliography-Using software reference management software), Ethics and Plagiarism.

UNIT-2: RESEARCH DESIGN & INTELLECTUAL PROPERTY RIGHTS
Selecting the research problem; Steps involved in defining a research problem (with illustrations); Need and Types of research designs; Basic principles of experimental designs, IPR and research, Indian Patent Act (Prior and 1970), Prerequisites of patentable subject matter, Types of IPR, TRIPS, WTO and Paris agreement</td></tr>
</table>

	UNIT-3: SAMPLING AND TESTING HYPOTHESES Concept of Independent and Dependent Variables; Steps in sampling design; Different types of sample designs; how to select a random sample? Hypothesis testing of means, Null Hypotheses and Alternative Hypothesis, Level of significance, Type I and Type II error. **UNIT-4: ANALYSIS OF VARIANCE AND OTHER TESTS** Setting up ANOVA table; one-way and two-way ANOVA; Parametric tests (z, t, F, and Chi-square tests); Nonparametric or distribution-free tests (Sign test, Wilcoxon test, Rank-sum test, Kendall's coefficient)
Reference Books	• Chap, LE, T. (2003). *Introductory Biostatistics* (1st Edition). John Wiley and Sons Publication. • Johnson, R. A. (2018). *Miller and Freund's Probability and Statistics for Engineers* (9th Edition). Pearson Education limited. • Kumar, R. (2012). *Research Methodology: As Step by Step Guide for Beginners* (2nd Edition). Pearson Education Australia. • Sharma, K. (2015). *Business Statistics* (12th Edition). Krishna Prakashan Media (P) 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-IX

Course: BT-305: Practicals

<table>
<tr><td>Course Code</td><td colspan="2">BT-305</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">2023-2024</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 molecular biology, bioprocess technology, molecular genetics, industrial biotechnology and biostatistics.</td></tr>
<tr><td>Course Objective</td><td colspan="2">The course gives students a hands-on experience and learn how to plan, execute and draw inference from the laboratory practical.</td></tr>
<tr><td>Course Outcomes</td><td colspan="2">CO1 to CO4: By performing the set of experiments students will learn DNA isolation, PCR and RTPCR.
CO5 to CO8: Student will be equipped with the knowledge, skills and competencies necessary to contribute effectively to the field of fermentation, including upstream and downstream process design and product recovery.
CO9 to CO12: The students will be able to perform various practical regarding to skills for cancer biology including MTT, micronucleus and DNA fragmentation assay.
Elective Paper–I: CO13 to CO16: The students will be able to study about industrial biotechnology including diagnostic kit and report writing.
Elective Paper–II: CO17 to CO20: The students will have hands on Advances Biostatistics techniques like MS Excel.</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>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 colspan="2">Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td>Course Content</td><td>BT- 301
Core Paper I:
Advances in Molecular Biology

BT- 302
Core Paper II:
Bioprocess Technology</td><td>1. To perform DNA isolation from Blood/Plant
2. In vitro amplification of DNA by Polymerase Chain Reaction
3. To perform RNA extraction from Yeast
4. cDNA synthesis by Reverse transcriptase (RT) PCR

5. Determination of thermal death point and thermal death time of microorganism for design of sterilizer.
6. Determination of Oxygen Transfer Rate (OTR) by Sulphite oxidation method.
7. Preparation of standard curve for estimation of Ethanol and Citric acid.</td></tr>
</table>

	BT-303 Core Paper III: Cancer and Applications of Molecular Genetics	8. Fermentative production of ethanol/wine using different substrates and product recovery. 9. To perform MTT/MTS assay. 10. To perform Micronucleus assay. 11. To perform DNA fragmentation assay. 12. Estimation of GST activity in serum.
	BT-304 Elective Paper-I Industrial Biotechnology	13. Diagnostic kit based analysis to study condition of liver/kidney/cholesterol content from the given urine/blood sample. 14. Study/Production of bio-based product using starch/chitosan derived from waste (banana peel/potato peel/shell) 15. Report on Public Sector/Private Sector Industrial Case study for Sustainability/Circular Economy 16. Report on Regulatory authorities in Industrial Biotechnology
	BT-304 Elective Paper-II Research Methodology, Biostatistics and IPR	17. List five relevant journals for the given abstract using journal finder. (Give details like Impact factor and Indexing of the journal) 18. Place the reference citation at the appropriate place using reference management software 19. Testing Null Hypothesis for the given experimental condition using MS-Excel 20. Perform One-way/Two-way ANNOVA for the given condition using MS-Excel
Reference Books	• Aneja, K. R. (2007) Experiments in Microbiology, Plant Pathology and Biotechnology, Revised 4th Edition, New Age International Publishers, New Delhi. • Aneja, K. R. (2014) Laboratory Manual of Microbiology and Biotechnology, 1st Edition, MedTech, New Delhi. • Cappuccino, J. and Sherman, N. (2014) Microbiology-A Laboratory Manual, 10th Edition, Pearson Education Ltd, United Kingdom. • Patel, R. J. and Patel, K. R. (2017) Experimental Microbiology Volume 2, 9th Edition, Aditya, Ahmedabad. • Beevi, R. K., Fathima, S. A., Fathima, T. A., Rizwana Beevi, K., Sameera Fathima, A. R., Thahira Fathima, A. I., Thameemunisa, N., Noorjahan, C. M., & Deepika, T. (2020). Bioplastic synthesis using banana peels and potato starch and characterization. *International Journal of Scientific and Technology Research*, *9*(1), 1809–1814. www.ijstr.org • Fernandez, J. G., & Ingber, D. E. (2014). Manufacturing of large-scale functional objects using biodegradable chitosan bioplastic. *Macromolecular Materials and Engineering*, *299*(8), 932–938. https://doi.org/10.1002/mame.201300426	

	• Bilirubin Estimation in Serum Kit (CAT. NO. BTK 130956), BIO-RAD Laboratories, Inc. (Bilirubin estimation using Jendrassik and Grof Method) • Johnson, R. A. (2018). *Miller and Freund's Probability and Statistics for Engineers* (9th ed.). Pearson Education limited.
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-IX

Course: BT-306: Medical Imaging & Nuclear Medicine

<table>
<tr><td>Course Code</td><td>BT-306</td></tr>
<tr><td>Course Title</td><td>Medical Imaging & Nuclear Medicine</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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>To provide a knowledge of biological imaging.
This course also aims to learn various techniques of biological imaging.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to be acquainted with the biology of imaging. Diagnostic imaging techniques help narrow the causes of an injury or illness and ensure that the diagnosis is accurate. These techniques include X-rays, computed tomography (CT) scans, and magnetic resonance imaging (MRI) scans.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will learn the basics, types & principles of radiation.
CO2: Students will learn the basics, biological effects & techniques of Ultrasound.
CO3: Students will learn the external & internal dosimetry in nuclear medicine.
CO4: Students will learn the effects & regulation, symptoms, conditions & protection of radiation.</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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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology</td></tr>
<tr><td>Course Content</td><td>UNIT-1: INTRODUCTION TO RADIATION
Basic physics of ionizing radiation, Types of ionizing radiation and their characteristics, Basic principle of a magnetic resonance (MRI) scanner, Biological effects of time-varying magnetic field gradients (MRI)

UNIT-2: ULTRASOUND
Basics of Ultrasound in medical imaging, Equipment and techniques to acquire ultrasound images, Biological effects of ultrasound, Biological effects of planar X-ray imaging

UNIT-3: NUCLEAR MEDICINE
The principles of nuclear medicine imaging and therapy, External dosimetry issues specific to nuclear medicine, Internal dosimetry in students will learn the basics, types & principles of radiation nuclear medicine, The medical internal radiation dosimetry (MIRD) method</td></tr>
</table>

	UNIT-4: RADIATION EFFECTS AND REGULATION Conditions for acute radiation syndrome (ARS) and Stages of ARS, Symptoms associated with the clinical syndromes of ARS, Expressions of risk and organizations, Radiation protection recommendations and regulations
Reference Books	• Charles A Kelsey, Phillip H Heintz, Daniel J Sandoval, Gregory D Chambers, Natalie L Adolpht, Kimberly S Paffett, Radiation biology of medical imaging,1st edition, 2014 John Wiley & Sons. • V. Santhi, D. P. Acharjya, M. Ezhilarasan, Biomedical Imaging Techniques, 2016, IGI Global book.
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 [Academic Year of Implementation: -2023-2024]

Teaching and Examination Scheme for Semester- X

Course Code	Paper	Teaching Schedule Hours/Week	Exam Schedule			Total Theory/Practical (Marks)	Credits
			Duration (Hours)	Internal Marks	External Marks		
	A. Research Based						
BT: R-401	Dissertation (4 Months)	32	3	120	280	400	16
BT: R-402	Review of Published Research Paper/Article	4	3	30	70	100	4
BT: R-403	Seminar Presentation	4	3	30	70	100	4
	Total			180	420	600	24

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology [Academic Year of Implementation: -2023-2024]

Teaching and Examination Scheme for Semester- X

Course Code	Paper	Teaching Schedule Hours/Week	Exam Schedule			Total Theory/Practical (Marks)	Credits
			Duration (Hours)	Internal Marks	External Marks		
	B. Skill Based						
BT: S-401	Essential skills for Biopharmaceutical Industry	4	3	30	70	100	4
BT: S-402	Essential skills for Bio-services and Bio-Agri Industries	4	3	30	70	100	4
BT: S-403	Essential skills for Clinical Laboratories	4	3	30	70	100	4
BT: S-404 BT: S-404	**Elective Paper-I** Developmental Biology **Elective Paper-II** Drug Discovery & Development	4	3	30	70	100	4
	Practicals:						
BT: S-405	**Skill Based Practical**	12	4 h X 3 days = 12 h	50	100	150	6
BT: S-406	**Skill enhancement elective paper:** Biotechnology in Forensics/ 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-X

A. Research Based

BT: R-401: Dissertation on Biotechnology (Duration for work: Minimum 4 Months)

A project work should be done individually on topic related to any one of the following area justifying Animal, Microbial or Plant Biotechnology. The candidate may be allowed to work at some outside institutions as specified in rules and guidelines. Thesis will be sent for evaluation by college as per directions given by Chairman/Chairperson appointed for BT: R-401 to external examiner for assessment. Candidate has to present his/her work in the form of presentation in external examination.

Guidelines & Rules for Dissertation:

-Identification and confirmation of institute for dissertation shall be done during Semester-IX. Problem identification (Aim and Objectives) and literature survey in consultation of internal guide/co-guide shall also be done during Semester-IX.

-Those that opt for pursuing dissertation at other place will get 50% of their fees collected by other institute with maximum limit of Rs. 10,000/- from mother institute from the fees he/she has paid of respective semester.

-Place of dissertation other than his/her institute shall be a one of the following:

1. All UGC recognized University Post Graduate Departments.
2. All Agricultural Universities.
3. All National and State Level Research Institutes having DSIR/NABL certification.
4. Reputed Biotechnology/Pharmaceutical Industries having R & D and Q. C. facilities.

-In external evaluation of dissertation, 100 marks shall be for thesis assessment and 180 marks shall be for overall work done for fulfilment of objectives, power point presentation and viva-voce examination.

BT: R-402: Review of Published Research Paper/Article:

Oral presentation will have to be made on a selected research paper from the reputed Journal by the candidate before external examiners. List of 15 research articles shall be recommended by Board of Studies in Biotechnology every year.

BT: R-403: Seminar Presentation:

A seminar presentation will be made during the external examination by the candidates before the examiners based on the theme area or recent developments in Animal/Microbial/Plant Biotechnology. Power point presentation should be done using 25-30 slides and total time period allotted to candidate shall be 15 minutes which will include time for viva-voce.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT

M. Sc. Integrated Biotechnology Semester-X

B. Skill Based

Course: BT: S-401: Essential Skills for Biopharmaceutical Industry

Course Code	BT:S-401
Course Title	**Essential Skills for Biopharmaceutical Industry**
Credit	4
Teaching per Week	4 Hours/Week
Minimum weeks per Semester	15 (Including Classwork, examination, preparation, holiday etc.)
Effective From	2023-2024
Purpose of Course	The course aims to impart the knowledge of theoretical aspects of Biopharmaceuticals development
Course Objective	To make students understand the applications, production and analysis of the Biopharmaceuticals.
Course Outcomes	**CO1**: The first unit of the course covers the introduction and classes of biopharmaceuticals, use of biopharmaceuticals for gene therapy and manufacture of Biopharmaceuticals. Additionally, it also covers the aspects related to pharmacokinetic, toxicological, and drug delivery issues. **CO2**: The second unit of the course allow the students to understand about the production of the Biopharmaceuticals. Within this segment, students will be able to understand about the sources of the biopharmaceuticals as well as upstream process methodologies involved in biopharmaceutical production. **CO3**: Once the upstream processes are completed, next step in biopharmaceutical production is downstream processes. The course also covers this aspect where students will be able to understand the theoretical aspects of cell disruption, product concentration, chromatographic purifications and final product formulation, etc. **CO4**: The last segment of the course focuses on final product analysis which includes identification of product impurities by using different approaches. It also covers the aspects, why and how the endotoxin and pyogenic contamination should be avoided in final pharmaceutical product.
Mapping between COs with PSOs	
Pre-requisite	Basics of Sciences
Course Content	**UNIT-1: DESIGN OF BIOPHARMACEUTICALS** Introduction and classes of biopharmaceuticals, Gene Therapy, Manufacture of Biopharmaceuticals, Pharmacokinetic, toxicological, drug delivery issues and Drug elimination from body

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

	Case Study of Biopharmaceuticals: Insulin Lispro (Humalog), Monoclonal Antibodies (Abciximab) and Vaccine production (mRNA vaccines) **UNIT-2: DEVELOPMENT FOR PRODUCTION OF BIOPHARMACEUTICALS** Cell line/Clone development, Sources of biopharmaceuticals, *Escherichia coli*, Animal cell culture systems, Additional systems, Upstream Processing for biopharmaceutical production, Cell banking system, Microbial cell fermentation, Mammalian cell culture system **UNIT-3: DOWNSTREAM PROCESSING OF BIOPHARMACEUTICALS** Cell disruption and Initial recovery, Product concentration, Chromatographic Purification, HPLC of proteins and recombinant proteins, Final product formulation **UNIT-4: ANALYTICAL METHODS FOR PRODUCT ANALYSIS** Protein based contaminants, Removal of altered forms of proteins, Detection of protein-based impurities, Immunological approaches of detection, Endotoxins and other pyrogenic contaminants
Reference Books	• Rang, H. P., Drug Discovery and development. Churchill Livingstone Elsevier, 2006. • Crommelin, D. J. A., Sindelar, R. D. and Meibohm. B., Pharmaceutical Biotechnology: fundamentals and applications. Informa Helthcare, 2008. • Walsh, G., Pharmaceutical Biotechnology: Concepts and Applications.John Wiley & Sons, 2007. • Walsh, Gary, and Brendan Murphy, eds. Biopharmaceuticals, an Industrial Perspective. Springer Science & Business Media, 1999. • Andreas Castan, Patrick Schulz, Till Wenger, Simon Fischer Ch-7 Cell line Development, Biopharmaceutical processing. Elsevier, 2018 • Rosa SS, Prazeres DMF, Azevedo AM, Marques MPC. mRNA vaccines manufacturing: Challenges and bottlenecks. Vaccine. 2021 Apr 15;39(16):2190-2200.
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-X

Course: BT: S-402: Essential Skills for ART and Bio-Agri Industries

<table>
<tr><td>Course Code</td><td>BT: S-402</td></tr>
<tr><td>Course Title</td><td>Essential Skills for ART and Bio-Agri Industries</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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>To provide a comprehensive knowledge of technical aspects of In Vitro Fertilization (IVF) as well as Allied technology and Agro-based Industries.</td></tr>
<tr><td>Course Objective</td><td>To understand the concept of assisted reproductive technology
To enable the student to handle the equipment with proper use and care and get used to with protocols involved in the process
To create enough thinking for Allied technologies used in Agro-industries.
To get proper working idea about Argo-based industries by few well developed Industries in same area.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will get overall idea regarding clinical and practical aspects of IVF
CO2: Students will have detailed knowledge of practical aspects along with the instrumentations, indications, complications of different techniques of ART
CO3: Students will learn and acquire knowledge about allied enterprises which is backbone of almost all economies in the world.
CO4: Argo-based Industries are those industries that have direct or indirect linkages with agricultural processes. Students will able to recognize the relationship between inputs and outputs in agriculture field to make effective and profitable decisions.</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>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 Science</td></tr>
<tr><td>Course Content</td><td>UNIT 1: INTRODUCTION OF IN VITRO FERTILIZATION
Biological basis of fertilization, Indications for IVF, Initial Investigation of the infertile couple, Types of Media for embryo culture, Composition of Embryo culture media</td></tr>
</table>

	UNIT 2: HUMAN EMBRYO DEVELOPMENT AND ASSESSMENT OF VIABILITY Oocyte Retrieval and Selection, Sperm Evaluation and Preparation Method, Intracytoplasmic Sperm Injection: Technical Aspects, Quality Evaluation and Genetic Diagnosis of Embryo, Oocyte, Semen, and Embryo Cryopreservation **UNIT 3: SEED TECHNOLOGY & ALLIED ENTERPRISE** Types of seeds, Seed priming and Broadcasting, Assessment of genetic purity of lines and hybrids, Characterization of Lines and Hybrids for Intellectual Property Right Protection and PPV & FR, Sericulture, Apiculture and lac culture, Seed sterility and seed dormancy, Cryopreservation of seeds **UNIT 4: AGRO-INDUSTRIES: CASE STUDY** Godrej Agrovet Limited: Animal feed, Poultry and Palm oil, Advanta Limited: Leader in counterfeiting and grain, Monsanto India: Pesticides and seeds, National Agro-Industry: Ridge/Crop Planter and seed extractor, Raghuvansh Agrofarms Ltd: Dairy farming and Organic Fertilizer, Zanducare: serve humanity by bringing pure, authentic and effective Ayurvedic medicines.
Reference Books	• Gardner, D. et al. (2018) *Text book of assisted reproductive technologies: Laboratory perspectives* (5th ed). CRC Press. ISBN9781351228237 • Gardner, D. et al. (2018) Text *book of assisted reproductive technologies: Clinical perspectives* (5th ed). CRC Press. ISBN 9781498740180 • https://www.godrejagrovet.com/ • https://advantaseeds.com/in/ • https://kisanswaraj.in/monsanto-isation-of-indian-agriculture/ • https://modernagrotools.in/national-agro-industries/ • https://www.raghuvanshagro.com/ • https://zanducare.com/pages/about-zanducare • http://www.swamiasfa.com/ • https://jkpaper.com/
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-X

Course: BT: S-403: Essential Skills for Clinical Laboratories

<table>
<tr><td>Course Code</td><td>BT: S-403</td></tr>
<tr><td>Course Title</td><td>Essential Skills for Clinical Laboratories</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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>This course aims to provide an understanding of clinical biochemistry, microbiology and molecular biology. The course covers the fundamental principles of essential skills require for clinical laboratories. The course also covers routine tests for clinical laboratories with advanced automation techniques available in clinical laboratories</td></tr>
<tr><td>Course Objective</td><td>Objectives of course are to provide basic understanding of routine clinical laboratories. Application of knowledge of skills for clinical laboratories. Evaluation regarding feasibility of various routine analysis in lab to make student understand regarding how to develop essential skills for conducting laboratories.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Understand the principles of clinical biochemistry, microbiology and molecular biology
CO2: Apply knowledge of skills for conducting clinical laboratories
CO3: Understand the regulatory requirements for clinical laboratories. Analyse and interpret data from various analyses.
CO4: Keep student updated regarding latest development and application of skills in the field of clinical laboratories.</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>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>Fundamental understanding regarding applications in Biological Sciences</td></tr>
<tr><td>Course Content</td><td>UNIT-1: CLINICAL MICROBIOLOGY
Culture media: Compositions, types and forms, study of Escherichia, Salmonella, Leptospira and Mycobacterium, Routine urine examination.
UNIT-2: CLINICAL BIOCHEMISTRY
Liver Function tests, Kidney function tests, Cardiac profile tests, Laboratory determination of lipids in serum, Determination of glucose and Glycosylated haemoglobin
UNIT-3: DIAGNOSTIC SEROLOGY
Detection of rheumatoid factor and CRP, Detection of Dengue fever and leptospira IgM, Detection of malarial parasite by strip test and microscopy, Detection of allergens and antinuclear antibodies, Detection of viral diseases.</td></tr>
</table>

	UNIT-4: TOTAL QUALITY MANAGEMENT Total quality management, quality assurance, quality assessment, quality control, Internal quality control, financial aspects of laboratory management, Organization and operation of laboratory, ISO standards (QCI, NABH, NABL, CLSI)
Reference Books	• Godker P, Godker D.Textbook of medical laboratory Technology.3rd Ed. Mubai:Bhalani Publishing House;2014 • Murray P., ROSENTHAL K., PFALLER M Medical microbiology 8th Ed. Elsevier 2016
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-X

Course: BT-404 Elective Paper – I: Developmental Biology

<table>
<tr><td>Course Code</td><td>BT-404</td></tr>
<tr><td>Course Title</td><td>Developmental 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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>Developmental biology aims to understand how an organism develops, how a single cell becomes an organized grouping of cells that is then programmed at specific times to become specialized for certain tasks. This course also aims to learn various developmental events in different animal and plant models. Understanding the animal and plant development provides a means to regulate developmental stages and contributing to the efforts of achieving fitness of an organism.</td></tr>
<tr><td>Course Objective</td><td>The objective of the course is to be acquainted with the biology of regeneration, cell fates and lineages, metamorphosis, growth, genetic mechanisms of sex determination and differentiation of stem cells in adults as well as seedling development, flowering, seed formation, germination, and ageing in plants with respect to genes involved in developmental and regulation events in plants.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: Students will learn the basics of Developmental biology and its terminologies
CO2: Students will acquire the knowledge on cleavage pattern and early developmental events. The early stages of embryonic development are also crucial for ensuring the fitness of the organism.
CO3: Students will learn the organogenesis from different animal models.
CO4: Students will learn the organogenesis and developmental stages in plants. In general, students will learn the organogenesis and developmental stages in plants.</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>Basics Science</td></tr>
<tr><td>Course Content</td><td>UNIT-1: BASIC CONCEPTS OF DEVELOPMENT
Stem cell Potency, Types of specification and commitment, Morphogens and Morphogenetic gradients, Induction and Interaction of cells in Frog and Newt, Competence, Determination and differentiation, Cell fate and cell lineages, Cytoplasmic determinants</td></tr>
</table>

	UNIT-2: GAMETOGENESIS, FERTILIZATION, AND EARLY DEVELOPMENT Production of gametes, Cell surface molecules in sperm-egg recognition in sea urchin; Fertilization in Humans, Cleavage patterns, Blastula formation, Gastrulation and formation of germ layers in animals; Embryogenesis, Sex determination in placental mammals and Drosophila **UNIT-3: MORPHOGENESIS AND ORGANOGENESIS IN ANIMALS** Axes and pattern formation in Drosophila, Vulva formation in *Caenorhabditis elegans*, Eye lens induction in vertebrates, Limb development in Frog; Differentiation of neurons, Grey-crescent formation in Chick, Regeneration in Hydra **UNIT-4: MORPHOGENESIS AND ORGANOGENESIS IN PLANTS** Shoot and root development; Genetics of ABC model of flowering in *Arabidopsis thaliana*, Seed formation and germination, Seed dormancy, Embryo sac development and double fertilization in plants, programmed cell death, Aging and Senescence
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
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-X

Course: BT-404 Elective Paper – II: Drug Discovery and Development

<table>
<tr><td>Course Code</td><td>BT-404</td></tr>
<tr><td>Course Title</td><td>Drug Discovery and Development</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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>Drug discovery is becoming more and more crucial in biological sciences. The emphasis of the course is on how drug can be discovered by using bioinformatics tools. The focus of this subject area is on development of drugs using different bioinformatics tools and techniques like Autodock and PyRx.</td></tr>
<tr><td>Course Objective</td><td>Any use of tools and techniques is based on bioinformatics. Bioinformatics-based drug development of biological sciences is becoming more and more importance in today life.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: The student will be able clarify the underlying ideas, purposes, and importance of drug development.
CO2: The student will be able to clarify how modelling of protein and docking studies by using different tools and techniques.
CO3: The student will be able to study pathway of various diseases and finding of active site and ligand molecules.
CO4: The student will be able to describe the structure base drug discovery and optimisation of lead and ADME properties and prediction.</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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<tr><td>Pre-requisite</td><td>Basics Science</td></tr>
<tr><td>Course Content</td><td>UNIT - 1: INTRODUCTION TO DRUG DISCOVERY
Introduction drug design and discovery, Introduction: Natural product, Drugs; principles of drug Development. Bioinformatics in drug development, chemoinformatic and pharmacoinformatic. Applications of Drug Discovery and in silico Drug Designing

UNIT-2: MOLECULAR MODELING & DOCKING
History of molecular modelling, mechanical, graphical & computational models, molecular surface, molecular properties, interactions. Structure validation using Ramachandran plot and its significance. Application of docking in drug discovery, Docking tools Argus lab, PyRx.</td></tr>
</table>

	UNIT- 3: COMPUTER AIDED DRUG DESIGN In-silico Drug discovery Pipeline: Disease Pathways in KEGG, Target identification & validation, Active site identification, pharmacophore, removal of water molecules, Lead/Ligand identification. **UNIT- 4: STRUCTURE BASED DRUG DESIGN** Elucidation of target structure, active site characterization- cavity detection, critical residues; combinatorial chemistry, ligand libraries-chembank, KEGG, Ligand info, CSD, Drug bank; Structure based virtual screening; Ligand based design: ligand-based screening, lead optimization, ADME properties and prediction.
Reference Books	• Rastogi S. C., Mendiratta N., & Rastogi P. (2013), Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery), PHI Learning Pvt. Ltd. • Stroud R.M. and Moore J.F., 2008, Computational and structural approaches to drug discovery, Vol. 8, RSC Press. • Martin Y.C., 2010, Quantitative Drug Design: A Critical Introduction, 2nd Ed., CRC Press. • Smith J.H. and Williams H., 2006, Principles of Drug Design and Action, 4th Ed., CRC Press. • Abraham D.J., 2003, Burger's Medicinal Chemistry and Drug Discovery, 6th Ed., Vol. 1, John Wiley & Sons: New York. • Burger's Medicinal Chemistry, Drug Discovery and Development, 8th Ed., Vol. 1, 2021, John Wiley & Sons: New York. • Leach A. R., 2001, Molecular Modelling – Principles and Applications, 2nd Ed., PrenticeHall. • Strømgaard K., Krogsgaard-Larsen P. & Madsen U, 2016, Textbook of Drug Design and Discovery, 5th Ed., CRC Press. • Baron R., 2012, Computer-Aided Drug Design, Humana 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-X

Course: BT-405: Practicals

<table>
<tr><td>Course Code</td><td>BT-405</td></tr>
<tr><td>Course Title</td><td>Practicals</td></tr>
<tr><td>Credit</td><td>12</td></tr>
<tr><td>Teaching per week</td><td>4 h X 3 days = 12 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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>The set of experiments will give students direct exposure of practical knowledge in the field of biopharmaceutical industry, bio-services and bio-agri industries, clinical laboratories, developmental biology and drug discovery and development.</td></tr>
<tr><td>Course Objective</td><td>The course gives students a hands-on experience and learn how to plan, execute and draw inference from the practical's</td></tr>
<tr><td>Course Outcomes</td><td>CO1 to CO4: By performing the set of experiments students will learn antibiotic sensitivity assay, GMO detection kit, Aflatoxin detection kit and bacterial growth curve kit.
CO5 to CO15: The students will be able to perform various practicals regarding to skills for Bio-Services and Bio-Agri Industries and Clinical Laboratories.
Elective Paper–I: CO15 to CO19: The students will be able to study developmental stage on chick embryo, viability and germination of seeds.
Elective Paper–II: CO20 to CO25: The students will have hands on different modelling tools and toxicity prediction.</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>
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</td></tr>
<tr><td>Pre-requisite</td><td>Basics of Biology, Biotechnology, Biochemistry, Microbiology</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Course Content</td><td>BT:S- 401
Essential Skills for Biopharmaceutical Industry

BT- 402
Essential Skills for Bio-Services and Bio-Agri Industries</td><td>1. Antibiotic sensitivity assay
2. GMO detection kit
3. Aflatoxin detection kit
4. Bacterial growth curve kit

5. Visit to IVF lab
6. Demonstration of morphological characteristics of sperm & Sperm preparation techniques
7. Demonstration and basic idea regarding micromanipulator instrumentation and its operation
8. Microscopic examination of semen</td></tr>
</table>

		9. Visit to Agro-Industry 10. Identification and differentiation of Bt cotton and Non Bt cotton.
	BT-403 Essential Skills for Clinical Laboratories	11. Visit to automated clinical laboratory 12. Blood glucose estimation by GOD POD Method kit based 13. Urea/Uric acid estimation by kit-based method 14. Cholesterol/HDL estimation by kit-based method 15. SGPT/SGOT estimation
	BT-404 **Elective Paper-I** Developmental Biology	16. To determine Developmental stages in Chick embryo 17. To study cleavage types and patterns in early embryonic development (Demonstration). 18. To test the viability of seeds using tetrazolium salt. 19. To study the germination of dormant and non-dormant seeds 20. To study the effect of impermeable seed coat on dormancy
	BT-404 **Elective Paper-II** Drug Discovery & Development	21. Secondary structure prediction using various available tools. 22. Tertiary structure and function prediction using homology modeling 23. Validation of predicted structure by SAVS server or verify 3d. 24. Visualization of 3D protein structure using Rasmol, VMD, PyMol etc. 25. Determination of ADMET properties of compounds via different online tools. 26. Determination of active site of target proteins via different tools.
References	• https://egyankosh.ac.in/bitstream/123456789/57521/1/Unit%2015%20Development%20of%20Chick.pdf • https://w3.biosci.utexas.edu/experimentalembryology/ChickEmbryo.pdf • https://bio-protocol.org/pdf/bio-protocol884.pdf • https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5226122/ • https://www.jstor.org/stable/4353936 • https://www.who.int/docs/default-source/reproductive-health/srhr-documents/infertility/examination-and-processing-of-human-semen-5ed-eng.pdf • Rastogi S. C., Mendiratta N., & Rastogi P. (2013), Bioinformatics: Methods and Applications: (Genomics, Proteomics and Drug Discovery), PHI Learning Pvt. Ltd. • Stroud R.M. and Moore J.F., 2008, Computational and structural approaches to drug discovery, Vol. 8, RSC Press. • Leach A. R., 2001, Molecular Modelling – Principles and Applications, 2nd Ed., PrenticeHall.	

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-X

Course: BT-406: Biotechnology in Forensics

<table>
<tr><td>Course Code</td><td>BT-406</td></tr>
<tr><td>Course Title</td><td>Biotechnology in Forensics</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>2023-2024</td></tr>
<tr><td>Purpose of Course</td><td>Biotechnology-based forensic analysis of biological evidence is becoming more and more crucial in criminal investigations. The emphasis of the course is on how forensic scientists can enhance public safety and shield citizens from dangerous offenders. The focus of this subject area is on supporting victims and their families using methods like DNA sequencing and fingerprint analysis.</td></tr>
<tr><td>Course Objective</td><td>Any use of DNA forensics (identification) is based on biotechnology. Biotechnology-based forensic analysis of biological evidence is becoming more and more crucial in criminal investigations.</td></tr>
<tr><td>Course Outcomes</td><td>CO1: The student will be able clarify the underlying ideas, purposes, and importance of forensic science to human civilization.
CO2: The student will be able to clarify how medical and legal aspects of injuries are categorized, as well as how to recognise them.
CO3: The student will be able to elucidate about fundamentals of forensic biology and biological evidences.
CO4: The student will be able to describe the concepts of advanced developments in DNA profiling.</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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<tr><td>Pre-requisite</td><td>Basics Science</td></tr>
<tr><td>Course Content</td><td>UNIT 1: INTRODUCTION TO FORENSICS
Definition and Scope, History and development, Need and Principle, Police and Forensic science laboratories/institutions in India, Organizational Structure of a Forensic Science Laboratory/Institution, Functions and responsibility of Forensic scientist, Crime: Definition, types of crimes, causes of crime, Theories and prevention of crime, characteristics of criminals.

UNIT 2: FUNDAMENTALS OF FORENSIC BIOLOGY AND BIOLOGICAL EVIDENCES
Different domain of biology in investigation science, Types of Biological Evidences, Importance of biological evidences in forensic investigation, Procedure for collection and preservation of biological</td></tr>
</table>

	samples, Case study: Breakthrough achieved due to DNA analysis in solving cases in India as well as Globally **UNIT 3: METHODOLOGIES IN FORENSIC DNA ANALYSIS:** STR genotyping, Result of STR marker analysis and its interpretation, Single Nucleotide Polymorphism (SNPI and is applications in forensic investigation, Mitochondrial DNA analysis in Forensic investigation, Y-STR analysis and its significance, Non-human DNA analysis **UNIT 4: ADVANCED DEVELOPMENTS IN DNA PROFILING** LCN Typing, Prediction of physical characteristics, such as eye, hair, and skin colour based solely on DNA, Molecular autopsy, evolving technologies in forensic DNA analysis, Forensic tissue identification with nucleic acids: Classical, RNA based and DNA methylation-based approaches, Forensically important databases.
Reference Books	• Brown, T. A. (2016). *Gene cloning and DNA analysis: An introduction* (Seventh edition). John Wiley & Sons Ltd. ISBN: 978-1-119-64078-3 • Choudhuri, S., & Kotewicz, M. (2014). *Bioinformatics for beginners: Genes, genomes, molecular evolution, databases, and analytical tools*. Elsevier/AP. eBook ISBN: 9780124105102, Hardcover ISBN: 9780124104716 • Goodwin, W., Linacre, A., & Hadi, S. (2011a). *An introduction to forensic genetics* (2nd ed). Wiley-Blackwell. ISBN: 978-0-470-71019-7 • James, S. H., & Nordby, J. J. (Eds.). (2005). *Forensic science: An introduction to scientific and investigative techniques* (2nd ed). CRC Press. ISBN-78-0849327476 • Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2007). *Kuby immunology* (6. ed). Freeman. ISBN 9780716767640 • Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). *Lewin's genes XI* (11th ed). Jones & Bartlett Learning. ISBN: 9781449659851, 9781449659059 • Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2013). *Lehninger principles of biochemistry* (6th ed). W.H. Freeman. ISBN 1464109621
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