B. Sc. Biotechnology Course
Veer Narmad South Gujarat University, Surat

Semester	Semester V & VI (24+24 Credits)						Total Credits
Subject	Theory			Laboratory Work			
	Course	Credit	hours	Course	Credit	Hours	
Foundation Compulsory	1	2	2	-	-	-	2
Generic Elective	1	2	2	-	-	-	2
Core 1	6	12	12	1	6	12	18
Foundation Elective	1	2	2	-	-	-	2
Total	9	**18**	**18**	1	**6**	**12**	**24+24**

Semester-V

[Academic Year of Implementation: 2020-2021]

Core 1: Biotechnology

Course 1: BT-11: Immunotechnology
Course 2: BT-12: Clinical Hematology
Course 3: BT-13: Introduction to Nanobiotechnology
Course 4: BT-14: Introduction to Molecular Biology-II
Course 5: BT-15: Genetic Engineering
Course 6: BT-16: Bioethics, Biosafety and IPR

Practical Core 1: BTP-05: Biotechnology Practical

Semester-VI

[Academic Year of Implementation: 2020-2021]

Core 1: Biotechnology

Course 1: BT-17: Pharmaceutical Biotechnology
Course 2: BT-18: Introduction to Bioinformatics
Course 3: BT-19: Microbial Biotechnology
Course 4: BT-20: Environmental Biotechnology
Course 5: BT-21: Plant Biotechnology
Course 6: BT-22: Animal Biotechnology

Practical Core 1: BTP-06: Biotechnology Practical

VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-11: Immunotechnology

1. Course Code & Title

Course Code: BT-11 **Course Title:** Immunotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

The course of immunotechnology aims at the application of basic aspects of the immune system for diagnostics and therapeutics as well as the generation of vaccines for different diseases of mankind.

Course Objectives

- To learn about the production of various diagnostic tools like monoclonal antibodies and other methods that involves the immune system for disease detection.
- To learn about various types of autoimmune disorders and a variety of vaccines.

3. Course Content

UNIT-1: MONOCLONAL ANTIBODIES

1.1 Hybridoma Technology
1.2 Myeloma tumours
1.3 Procedure for generation of hybridomas
1.4 Human monoclonal antibodies
1.5 Chimeric Monoclonal Antibodies
1.6 Application of monoclonal antibodies
1.7 Monoclonal antibodies as Abzymes

UNIT-2: TECHNIQUES USED IN DIAGNOSIS

2.1 Precipitation
2.2 Agglutination
  2.2.1 Haemaglutination
  2.2.2 Bacterial agglutination
  2.2.3 Passive agglutination
  2.2.4 Agglutination inhibition
2.3 ELISA
2.4 Radioimmunoassay
2.5 Immunofluorescence
2.6 Immunochromatography

UNIT-3: HYPERSENSITIVITY & IMMUNE DISEASES

3.1 Hypersensitivity Type I, II, III & IV
3.2 Autoimmune diseases: Introduction, Types, Insulin Dependent Diabetes Mellitus and Rheumatoid Arthritis
3.3 Immunodeficiency: Introduction, Types, Severe Combined Immunodeficiency

UNIT-4: VACCINES

4.1 Attenuated and killed vaccines
4.2 Subunit vaccine (Toxoids, Capsule polysaccharides, Glycoproteins)
4.3 Multivalent subunit vaccine
4.4 DNA vaccine
4.5 Recombinant vector vaccine

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	The unit covers techniques used in the generation and application of monoclonal antibodies for disease diagnosis and therapeutic purposes.
2	Students will learn about various types of antigen-antibody reactions as well as analytical techniques used in the field of clinical/serological diagnosis.
3	The unit gives a brief account of various types of hypersensitivity reactions, various types of disorders generating due to hypersensitivity reactions, autoimmune diseases types and examples, immunodeficiency disorders.
4	This unit focuses on different types of vaccines: their production and application as a preventive means against various infections.

5. Recommended Learning Resources

- Kuby Immunology –Janis Kuby, Kindst, Gatsby And Osborne, 6th Edition, W. H. Freeman Publications.
- Immunology And Immunotechnology- Ashim Chakravarty, Oxford University Press, ISBN-13: 978-0-19-567688-4
- Microbiology- Lansing Prescott, John P. Harley, Donald A. Klein, 8th Edition, Mcgraw Hill Publication.
- Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson and John Walker, 7th Edition, Cambridge University Press.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-12: Clinical Hematology

1. Course Code & Title

Course Code: BT-12 **Course Title:** Clinical Hematology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

This course will introduce the study of the hematopoietic system including the relationship of hematologic diseases to diagnostic characteristics.

Course Objectives

- Fundamental understanding of blood and related diseases.
- Explain the importance of cellular or morphological characteristics of blood cells.
- Differentiate and enumerate cells on a peripheral blood smear.
- Explain the principles and methods of each test performed in the laboratory and the clinical significance.

3. Course Content

UNIT-1: Introduction to Hematology

1.1 Introduction to hematology and blood
1.2 Hematopoietic system
1.3 Hemoglobin derivatives
1.4 Classification of Anemia
1.5 Laboratory tests in iron deficiencies
1.6 The Thalassemia

UNIT-2: Methods in Clinical Hematology

2.1 Complete blood count
2.2 Complete hemogram
2.3 Collection of blood and anticoagulants
2.4 Routine hematology laboratory experiments
2.5 Hematology histograms

UNIT-3: Immunohaematology

3.1 Routine ABO Testing and ABO Antibodies
3.2 Inheritance of ABO Blood Groups
3.3 The Bombay Phenotype
3.4 Rh System: History, Molecular genetics and Clinical considerations
3.5 Introduction to ISBT blood group systems
3.6 The Cross matching tube test

UNIT-4: Blood Banking

4.1 Introduction to blood transfusion
4.2 Collection of blood from donor
4.3 Transfusion medicine
4.4 Selection of blood components
4.5 Use of blood derivatives; blood and blood component transfusions
4.6 Techniques used for the separation of blood constituents

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will understand the cause, prognosis, treatment and prevention of diseases related to study.
2	Students can focus on study of various tests of blood. For example, CBC (Complete Blood Count) test, this gives information on red blood cells, white blood cells and platelets. To make the proper functioning of the body, each type of blood cells need to perform well, and they have their own set of functions.
3	The unit immunohematology, ABO blood groups, its types and importance of blood grouping specially for blood transfusion.
4	The unit focuses on blood banking- it is the process that takes place in the laboratory to make sure that donated blood or its products which are safe before they are used in blood transfusions. Students will study about various components of blood, blood donors and various tests done in blood banking.

5. Recommended Learning Resources

- Godkar P, Godkar D. Textbook of Medical Laboratory Technology. 3rd Edition. Mumbai: Bhalani Publishing House; 2014.
- Harmening D. Modern blood banking & transfusion practices. New Delhi: Jaypee; 2013.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-13: Nanobiotechnology

1. Course Code & Title

Course Code: BT-13 **Course Title:** Nanobiotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

This is fundamental course to bridge areas in physics, chemistry and biology. It provides an introduction to the emerging field of bio-nanotechnology. It introduces concepts in nano-materials and their use with bio-components to synthesize and address larger systems.

Course Objectives:

- To equip the students with the concepts of biotechnology required for understanding the behaviour of nano-materials and biomaterials.
- To foster the knowledge, how modern research is harnessing biological systems to further nanotechnological endeavour.
- How modern science is gaining knowledge from natural systems that construct and control at the nanoscale.
- How general principles of structure and function within biological systems are used to construct functional devices within nanotechnology.

3. Course Content

UNIT-1: INTRODUCTION TO NANOTECHNOLOGY & NANOBIOTECHNOLOGY

1.1 Introduction to Nano-world
1.2 Types and properties of nanomaterials
1.3 Introduction to nanobiotechnology
1.4 Dominion of biological machines

UNIT-2: SYNTHESIS OF NANOMATERIALS

2.1 Approaches for synthesis of nanoparticles
2.2 Techniques for synthesis of nanostructures
2.3 Self-assembly techniques
2.4 Introduction to biosynthesis
2.5 What is biosynthesis? Why biosynthesis?

UNIT-3: MOLECULAR NANOTECHNOLOGY

3.1 Mastering the complex DNA nanostructure
3.2 DNA tweezers
3.3 DNA actuators
3.4 DNA scissors
3.5 Self-assembly of protein nanoarchitecture
3.6 Applications of protein nanostructures

UNIT-4: APPLICATIONS OF NANOBIOTECHNOLOGY

4.1 Application of carbon nanotubes in:
- 4.1.1 Diagnostic equipment
- 4.1.2 Surgical supplements
- 4.1.3 Tissue engineering
- 4.1.4 Gene delivery
- 4.1.5 Anti-carcinogenic activity
- 4.1.6 Drug delivery
- 4.1.7 Neurodegenerative disorder therapy

4.2 Use of liposomes

4.3 Photocatalysis of pollutants

4.4 Application in food and agriculture

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

Unit	SLO
1	• Comprehend the concept of "nanotechnology" and its interdisciplinary aspects • Learn basic properties of nanomaterials • Identify different types of nano materials and its applications
2	• Learn various approaches of synthesizing nanomaterials, their advantages and limitations • Understand the mechanism of preparation of variety of nanomaterial • Choose the suitable method of synthesis for further applications
3	• Analyze different types of DNA based Nanostructures • Know the importance of bio-mimicry to fabricate protein based nanoarchitecture
4	• Learn about recent development in the area of devices and therapy • Learn about nano diagnostics • Identify the application of carbon nanostructure for different day-to-day applications

5. Recommended Learning Resources

- Goodsell, David S. Bionanotechnology: Lessons from Nature. John Wiley & Sons, 2004.
- Pradeep, T. A textbook of Nanoscience and Nanotechnology. Tata McGraw-Hill Education, 2003.
- Sharon Madhuri et al Bio-nanotechnology, Ane Books Pvt. Ltd., 2012.
- Kulkarni, Sulabha K. Nanotechnology: Principles and Practices. Springer, 2014.
- Marulanda, Jose Mauricio, ed. Carbon Nanotubes: Applications on Electron Devices. BoD–Books on Demand, 2011.

- MOOC Programmes:
  a. https://nptel.ac.in/courses/118/107/118107015/
  b. https://nptel.ac.in/courses/118/106/118106019/

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-14: Introduction to Molecular Biology-II

1. Course Code & Title

Course Code: BT-14 **Course Title:** Molecular Biology-II

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is an advanced level course for the graduate students which gives a detailed account on transcription and translation with their regulatory aspects and also includes content imparting knowledge about protein maturation and post translational modifications.

Course objectives:

- ✓ To fetch knowledge about fundamental processes in detail at Molecular level.
- ✓ To understand the biochemistry of regulatory mechanisms controlling these fundamental processes.
- ✓ To get an idea on post-translational modifications and global regulatory networks.

3. Course Content

UNIT-1: TRANSCRIPTION AND GENETIC CODE

1.1 Transcription in Bacteria
1.2 Transcription in Eukaryotes
1.3 Transcription in Archaea
1.4 Establishment of Genetic Code
1.5 Characteristics of Genetic Code

UNIT-2: TRANSLATION

2.1 tRNA and amino acid activation
2.2 Ribosome Structure
2.3 Initiation of Protein Synthesis
2.4 Elongation and Termination of Protein Synthesis
2.5 Protein maturation and secretion

UNIT-3: REGULATION OF GENE EXPRESSION-I

3.1 Levels of Regulation
3.2 Regulation of Transcription initiation
3.3 Regulation of Transcription elongation
3.4 Regulation of Translation

UNIT 4: REGULATION OF GENE EXPRESSION-II

4.1 Post-translational Regulation
4.2 Global regulatory systems
4.3 Regulation of gene expression in Eukarya and Archaea
4.4 Gene regulation in Bacteriophage λ

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	This unit covers the concept of genetic codes and their features. It explains more about the transcription occurring in Bacteria, Eukaryotes and Archaea.
2	This unit emphasizes on synthesis of proteins, how are these proteins modeled to give a correct form. It also explains further about protein maturation and how these proteins are targeted to their destination on secretion.
3	The unit highlights about the levels of regulation involved in RNA and protein synthesis. It gives information on processes like splicing and RNA editing. It explains about the role of ubiquitylation and chaperon mediated protein folding
4	This unit provides information about regulation of genes in viruses additionally. It talks more about global regulatory systems.

5. Recommended Learning Resources

- Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2008). Prescott, Harley and Klein's Microbiology, 7th Edition, McGraw Hill International Edition.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-15: Genetic Engineering

1. Course Code & Title

Course Code: BT-15 **Course Title:** Genetic Engineering

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is an entry-level course imparting knowledge of genetic engineering to use different molecular biology techniques in order to create genetic modifications in different kind of organisms.

Course Objectives

- Fundamental understanding of importance, need and implication of rDNA technology
- To understand know-how's of rDNA technology, its tools and techniques.
- To understand generation, insertion, identification, and confirmation of cloned genes into different organisms.

3. Course Content

UNIT-1: RECOMBINANT DNA TECHNOLOGY AND ENZYMES

1.1 What is gene cloning and its importance
1.2 Range of DNA manipulative enzymes
1.3 Restriction Endonucleases
1.4 Ligation enzymes

UNIT-2: CLONING VECTORS

2.1 Vectors based on Plasmids.
2.2 Vectors based on M13
2.3 Vectors based on Phage Lambda
2.4 Vectors for Yeasts and other Fungi
2.5 Vectors for higher plants
2.6 Vectors for animals

UNIT-3: TECHNIQUES USED IN GENETIC ENGINEERING-I

3.1 Transformation
3.2 Identification of recombinants
3.3 Insertion of phage DNA
3.4 Introduction of DNA to non-bacterial cells

UNIT-4: TECHNIQUES USED IN GENETIC ENGINEERING-II

4.1 Colony and Plaque Hybridization
4.2 Practical uses of hybridization probing
4.3 Polymerase Chain Reaction: Outline, Details, Studying products, Real-Time PCR
4.4 DNA Sequencing: Chain termination, Shotgun, Clone Contig methods

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will develop an understanding on basic idea of gene cloning, its importance, types of enzymes used as tools in gene cloning as being prime players.
2	As being carriers of genes of interest, students will understand about different types of vectors and comparative advantages offered by each of them so that proper choice of vector can be done.
3	Students will gain knowledge about techniques to insert prepared clones into different organisms and identification of recombinants.
4	The unit focuses on and thus provides knowledge of different techniques to, first, identify and then further validation of recombinants.

5. Recommended Learning Resources

- Brown TA. Gene cloning and DNA analysis: an introduction. John Wiley & Sons; 2016 Jan 19.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BT-16: Bioethics, Biosafety and IPR

1. Course Code & Title

Course Code: BT-16 **Course Title:** Bioethics, Biosafety and IPR

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

- ✓ To acquaint, introduce & emphases students about Bioethics, Biosafety & IPR.
- ✓ They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health, Stem cells, organ transplant etc.
- ✓ They will gain more insights into the regulatory affairs & see the ethical side of scientific research.
- ✓ They will be able to implement good lab practices & biosafety mechanisms.

3. Course Contents

UNIT-1: INTRODUCTION TO BIOETHICS AND BIOSAFETY

1.1 Introduction and need of Bioethics and Biosafety
1.2 Applications of Bioethics
1.3 Applications of Biosafety
1.4 Bioethics and its relationship with other sciences
1.5 Levels of Biosafety (I to IV with respect to plant, animal and microbiology laboratories)

UNIT-2: INTRODUCTION TO ETHICAL, LEGAL AND SOCIAL IMPLICATIONS

2.1 Human Genome Project
2.2 GMO: Foods & Crop
2.3 Stem Cell Research
2.4 Drug testing on Human volunteers
2.5 Organ transplantation

UNIT-3: BIOSAFETY

3.1 Risk assessment
3.2 Containment
3.3 Handling and disposal of chemical hazardous waste
3.4 Handling and disposal of biological hazardous waste
3.5 Immunization and first aid for biotech laboratory workers

UNIT-4: INTELLECTUAL PROPERTY RIGHTS

4.1 Introduction to IPR
4.2 Types of IPR
4.3 International framework for IP protection
4.4 GATT, WTO, WIPO and TRIPS
4.5 PVP and Farmers' Right
4.6 Prior Art
4.7 Patent Database: USPTO, EPO and IPO

4. Course Learning Outcomes/Students Learning Outcomes (SLOs)

UNIT	SLO
1	To provide basic knowledge about concepts of Bioethics & Bio safety, their applications & significance.
2	To provide awareness & understanding regarding ELSI of few of the latest research, technologies & advances of science & their impact on human life & society.
3	Students will be made aware of different preventive methods & good biosafety practices.
4	To inform students about IPR's basic & provide knowledge about different Acts, regulations, laws, policies etc

5. Recommended Learning Resources

- Sateesh MK. Bioethics and biosafety. IK International Pvt Ltd; 2008 Aug 25.
- Singh BD. Biotechnology expanding horizons. Kalyani publishers; 2007.
- Ganguli P. Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill Publishing Company; 2001.
- National IPR Policy | Department for Promotion of Industry and Internal Trade | MoCI | GoI [Internet]. Dipp.gov.in. 2020 [cited 19 June 2020]. Available from: https://dipp.gov.in/policies-rules-and-acts/policies/national-ipr-policy

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-V

BTP-05: Biotechnology Practical

1. **Course Code:** BTP 05
2. **Course Title:** Biotechnology Practicals
3. **Course Overview & Course Objectives**
   Practicals are designed to address laboratory skills relevant to the fields of biochemistry, genetic engineering, clinical serology and hematology.

   - ✓ To equip students with essential skills for the further explorations of bioterchnology research.
   - ✓ To teach clincial laboratory skills of serology and hematology.

4. **Course Content**

1. Estimation of reducing sugars by Cole's method
2. Estimation of reducing sugars by DNSA method
3. Estimation of proteins by Folin-Lowry method
4. Seperation of amino acids by TLC
5. Radial precipitation test (Mancini's)
6. Detection of HIV by ELISA.
7. Detection of Hepatitis B surface antigen by direct ELISA.
8. Dreyer's Tube test for diagnosis of Typhoid
9. Immunochromatography for diagnosis of Malaria/Typhoid.
10. Synthesis of AgNPs by using sodium citrate.
11. Synthesis of AgNPs by using fungal/bacterial methods.
12. *In vitro* study of antimicrobial activity of AgNPs against bacteria.
13. Isolation of plasmid DNA from E. coli.
14. Extraction and Purification of bacterial DNA using spin column.
15. Restriction digestion of plasmid vector.
16. Transformation of bacterial cells by $CaCl_2$ method.
17. Blood Crossmatching test (Tube method)
18. Coombs Test (Indirect)
19. Study of milk quality by Methylene Blue Reduction Test
20. Enrichment and isolation of coliphages from sewage

5. **Course Learning Outcomes/ Students Learning Outcomes (SLOs)**

Practicals	SLO
Practical No. 1 to 4	Fundametnal analytical skills for the assay of common biomolecules
Practical No. 5 to 9	Learning routine diagnostic methods in clinical serology
Practical No. 10 to 12	Learning common methods for the synthesis of metal nanoparticles and study their effect on cells
Practical No. 13 to 16	Learning essential laboratroy skills for genetic engineering
Practical No. 17 and 18	Skill of important tests performed in clinical haematology
Practical No. 19 and 20	Important experimental knowhow of dairy microbiology and virology experiments.

5. <u>Recommended learning Resources</u>

- Patel R J, Patel KR. Experimental microbiology Part II. Aditya Publication, Ahmedabad. 2016.
- Mu P, Plummer DT. Introduction to practical biochemistry. Tata McGraw-Hill Education; 2001.
- Sambrook J, Fritsch EF, Maniatis T. Molecular cloning: a laboratory manual. Cold spring harbor laboratory press; 1989.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-17: Pharmaceutical Biotechnology

1. Course Code & Title

Course Code: BT-17 **Course Title:** Pharmaceutical Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

Pharmaceutical Biotechnology is intended to provide the student with a working knowledge of the preparation, stability and formulation of different protein and peptide drugs such as antisense agents, transgenic therapeutics etc. Current FDA approved biotechnology drugs such as human insulin; growth hormones etc. will be discussed.

Course Objectives

- The knowledge gained in this course would be used to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related drugs and products on the market.
- Novel formulation approaches for better delivery of biotechnology derived drugs, such as nasal sprays, liposomes and biodegradable polymer will be addressed.
- The delivery of peptides and proteins by the parenteral, oral, transdermal and nasal routes of administration will also be discussed.
- Drug Designing and development will be discussed. The process of Pharmacokinetics and Pharmacodynamics will also be discussed.
- The field of Regulatory affairs will also be addressed.

3. Course Content

UNIT-1: PHARMACEUTICALS, BIOLOGICS & BIOPHARMACEUTICALS

1.1 Introduction to pharmaceutical products
1.2 Biopharmaceuticals and pharmaceutical biotechnology
1.3 History of the pharmaceutical industry
1.4 The age of biopharmaceuticals
1.5 Biopharmaceuticals: Current status and future prospects

UNIT-2: DRUG DELIVERY & THERAPEUTICS

2.1 Drug delivery
    2.1.1 Liposome
    2.1.2 Nasal spray
    2.1.3 Biodegradable polymer
    2.1.4 Osmotic
2.2 RNAi Therapeutics
2.3 Antisense Technology

2.4 Enzyme of Therapeutic value- Superoxide dismutase, DNAse
2.5 Hormone as therapy- Insulin

UNIT-3: DRUG DISCOVERY & DEVELOPMENT
3.1 Drug discovery and development
3.2 Clinical pharmacology
3.3 Pharmakokinetics
3.4 Pharmacodynamics
3.5 Toxicology studies- Reproductive toxicity, Teratogenicity, Carcinogenicity

UNIT-4: REGULATORY AFFAIRS
4.1 Food & Drug Administration
4.2 The investigational new drug application
4.4 Regulatory procedure
4.5 Role of regulatory affairs department
4.6 ICH guidelines

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will able to gain basic idea of Drugs, Bio-Pharmaceuticals and role of Biotechnology.
2	Students will get an idea on drug delivery methods and mechanism.
3.	Students will come across understanding effect of drug on body is and how it metabolized.
4.	Able to understand aim of regulatory concept, its scope and methodology of approval of drug along with the ICH guidelines.

5. Recommended Learning Resources

- Walsh G. Pharmaceutical biotechnology: concepts and applications. John Wiley & Sons; 2013 Apr 25.
- Rang HP. Drug Discovery and Development. Technology in Transition. 2012 Jul 20:3.
- Ho RJ, Gibaldi M. Biotechnology and Biopharmaceuticals. Transforming Proteins and Genes into Drugs. 2003.
- Jogdand SN. Medical biotechnology. Himalaya Publishing House; 2008.
- Sobti RC, Pachouri SS. Essentials of biotechnology. Ane Books Pvt. Limited; 2009.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-18: Introduction to Bioinformatics

1. Course Code & Title

Course Code: BT-18 **Course Title:** Introduction to Bioinformatics

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

This course will give students an introduction to the basic techniques of Bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases. The students will become familiar with the use of a wide variety of internet applications using sequence alignment tools, biological database and will be able to apply these methods in future studies and research work.

Course Objectives

- To make students more familiar with Bioinformatics.
- To provide basic idea of Biological database and its types for the studies.
- To study Homology, pairwise alignment and multiple sequence alignment and provide insight to perform comparative analysis of known and unknown sequences.
- To create zest of learning and utilize NCBI web portal and Bioinformatics for better understanding of Biotechnology.

3. Course Content

UNIT-1: INTRODUCTION TO BIOINFORMATICS

1.1 A word on Bioinformatics
- 1.1.1 Branches of Bioinformatics
- 1.1.2 Aims of Bioinformatics
- 1.1.3 Scope and Research area of Bioinformatics

1.2 Organization of Bioinformatics in India
- 1.2.1 BTIS
- 1.2.2 Bioinformatics Server in India
- 1.2.2.1 Protein structure prediction server
- 1.2.2.2 Genomics and Proteomics server
- 1.2.2.3 Conformational epitope prediction server

1.3 Indian IT Companies involved in Bioinformatics Initiatives

UNIT-2: BIOLOGICAL DATABASE

2.1 Primary Database- Nucleotide sequence databases (EMBL, DDBJ, GenBank), Protein sequence databases (Swiss Prot, TrEMBL)

2.2 Secondary Database- Nucleotide sequence-TIGR, Protein sequence-PROSITE.

2.3 Structure Database- PDB, SCOPE, CATH

2.4 Metabolic Pathway Database- KEGG
2.5 Database retrieval tool- SRS, Entrez
2.6 Literature Database- PubMed

UNIT-3: PAIRWISE SEQUENCE ALIGNMENT

3.1 Concept of Alignment - Global alignment, Local Alignment, Gap Penalty
3.2 Methods for sequence alignment: Dot matrix method, Dynamic Programming algorithm (Smith waterman & Needlemen Wunch algorithm).
3.3 Basic Local Alignment Search Tool
3.4 FASTA

UNIT-4: MULTIPLE SEQUENCE ALIGNMENT

4.1 Introduction to Multiple sequence alignment.
4.2 Methods of Multiple sequence alignment (Sum of Pairs, Progressive, Iterative),
4.3 Application of Multiple sequence alignment.
4.4 Tools for Multiple sequence alignment: Clustal Omega.

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	The unit convey students about understanding of Bioinformatics and its component along with its utility in Biotechnology.
2	The unit will explore students towards biological database and its scope for study of literature and as well as metabolic pathway database.
3.	The unit consider the pairwise sequence alignment and explain the analysis of concept of similarity along with tools.
4.	The unit consider the multiple sequence alignment and explain the analysis of concept of checking similarity along with tools.

5. Recommended Learning Resources

- Ghosh Z, Mallick B. Bioinformatics: Principles and Applications. Oxford University Press; 2008.
- Attwood TK, Parry-Smith DJ. Introduction to bioinformatics. Essex, GB: Pearson Education; 1999.
- Bosu O, Thukral SK. Bioinformatics: Experiments, Tools, Databases, and Algorithms. Oxford University Press, Inc.; 2007 Sep 6.
- Murthy CSV. Bioinformatics. Himalaya Publishing House; 2016.
- Rastogi SC, Rastogi P, Mendiratta N. Bioinformatics Methods And Applications: Genomics Proteomics And Drug Discovery 3Rd Ed. PHI Learning Pvt. Ltd.; 2008.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-19: Microbial Biotechnology

1. Course Code & Title

Course Code: BT-19 **Course Title:** Microbial Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

Microbial Biotechnology is intended to provide the student with a working knowledge of the Microorganisms and their role in biotechnological process such as Fermentation. The course involved discussion from designing of fermenter to strain improvement for fermentation industries.

Course Objectives

- To understand the commercial applications of microorganisms.
- To learn concept of isolating enzyme and antibiotic producing microorganisms.
- Acquire the ability and knowledge to isolate and screen the commercially important bacteria from different sources.
- Understand how microbes are useful to human beings and how their products are commercialized.
- The designing of fermenter and role of each component will be explored.

3. Course Content

UNIT-1: INTRODUCTION TO MICROBIAL FERMENTATION

1.1 Concept of fermentation technology
1.2 Chronological development of industrial fermentation technology
1.3 Range of fermentation processes and products
1.4 Fermentation process outline
1.5 Fermentative production of Citric acid, Ethanol and Penicillin (Outline)

UNIT-2: MICROBIAL SCREENING AND PRESERVATION

2.1 Concept of microbial screening
2.2 Primary and Secondary screening
2.3 Isolation of industrially important microorganisms:
  2.3.1 Methods utilizing selection of desired characteristics
  2.3.2 Methods not utilizing selection of desired characteristics
2.4 Future potential and needs of microbial screening
2.5 Maintenance and Preservation of Microbial cultures

UNIT-3: IMPROVEMENT OF MICROORGANISMS

3.1 Types of Microbial mutants and their practical implications
3.2 Isolation of microbial mutants (Outline).
3.3 Selection of mutants producing high yield of primary & secondary metabolites
3.4 Parasexual cycle
3.5 Protoplast fusion

UNIT-4: FERMENTOR DESIGN

4.1 Basic functions of fermentor
4.2 Aseptic operation and Containment
4.3 Factors involved in fermentor design
4.4 Typical batch fermentor
4.5 Air-lift bioreactor and CSTF

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	This unit explain students about basics of fermentation technology.
2	Through this unit students will get knowledge on microbial culture preservation and screening.
3.	Students will come across understanding how to improve microbial strain for the better production of product.
4.	By studying this unit students are able to understand design of fermenter for microbial biotechnology perspective.

5. Recommended Learning Resources

- Stanbury PF, Whitaker A, Hall SJ. Principles of fermentation technology. Elsevier; 2013 Oct 22.
- Crueger W, Crueger A. Biotechnology: A Textbook of Industrial Microbiology. Madison: Sinauer Tech.; 1989.
- Patel AH. Industrial microbiology. Macmillan India; 1984.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-20: Environmental Biotechnology

1. Course Code & Title

Course Code: BT-20 **Course Title:** Environmental Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is a course of Environmental Biotechnology combining biology with professional engineering wherein students are made aware of protecting and save environment; with use of bioremediation techniques using microbes, waste disposal into the environment and energy production using microorganisms.

Course Objectives

- To provide basic knowledge related to energy production using varieties of microorganisms.
- To understand the concept of environmental bioremediation techniques and different microbes and plants that can be used for the same purpose.
- To understand the role of microorganisms in waste treatment, characterize waste according to its hazardous nature and accordingly manage and dispose it.
- To learn about bioleaching, metal precipitation and biopolymers and their uses.
- Syllabus will help the students for making their career in the field of Environmental biotechnology, help in the research for using varieties of different organisms for bioremediation and waste treatment technologies.

3. Course Content

UNIT-1: BIOENERGY

1.1 Energy resources
1.2 Biogas technology
1.3 Bioethanol production from cellulosic waste
1.4 Microbial Hydrogen production
1.5 Biodiesel from Jatropha

UNIT-2: BIOREMEDIATION

2.1 Principles of bioremediation
2.2 Factors responsible for bioremediation
2.3 Bioremediation strategies: *In situ* & *Ex situ*
2.5 Metal & Organic Phytoremediation

UNIT-3: WASTE MANAGEMENT

3.1 Characteristics of waste water
3.2 Aerobic biological waste water treatment: Activated sludge and Oxidation ponds
3.3 Anaerobic biological waste water treatment: UASB and Anaerobic baffled reactor
3.4 Conventional solid waste treatment technologies
3.5 Municipal waste management rules
3.6 Composting: Design aspects and process
3.7 Vermicomposting

UNIT-4: SOME SPECIAL PROCESSES

4.1 Abatement of Air pollution
4.2 Bioleaching: Types and Methods
4.3 Metal Precipitation
4.4 Biopolymers: Types and Preparation
4.5 Properties and Practical applications of PHA

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will learn about the organism's metabolic processes and their byproducts which can be used as energy sources.
2	Students will develop an understanding related to bioremediation, how it is helpful in treating environmental pollution problems and various bioremediation techniques.
3	Students will learn about the waste characterization based on their nature, use of aerobic and anaerobic techniques for waste treatment, and use of earthworms in increasing soil fertility by complete degradation of waste
4	This unit covers the processes such as Bioleaching, metal precipitation and biopolymers where students will learn about various microbes which can be used for bioleaching, metal precipitation and their removal from effluents and thereby from leaking into the environment and production of biopolymers and their uses.

5. Recommended Learning Resources

- Fulekar MH. Environmental biotechnology. CRC Press; 2010 Jul 19.
- Thakur IS. Environmental Biotechnology. IK International, New Delhi. 2006.
- Pepper IL, Gerba CP, Gentry TJ, Maier RM, editors. Environmental microbiology. Academic press; 2011 Oct 13.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-21: Plant Biotechnology

1. Course Code & Title

Course Code: BT-21 **Course Title:** Plant Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

It is a fundamental course to understand the core concepts and fundamentals of plant biotechnology specifically plant tissue culture in order to promote in-vitro cultivation of different plant parts. This course will further augment student knowledge about different techniques utilized for conservation and mass propagation of rare and endangered plant species and medicinal plants.

Course Objectives

- Key concept and understanding of media and nutrients, plant growth regulators needed to propagate tissue culture derived plants.
- Thorough knowledge to grow, maintain and manipulate plant material in a laboratory setting for research and breeding purposes
- To understand possible applications and limitations of different techniques utilized in plant tissue culture.

3. Course Content

UNIT-1:

1.1 Introduction and History of Plant tissue culture.
1.2 Laboratory Requirement and General Techniques.
1.3 Tissue culture Media (Murashiage and Skoog, Gamborg, Rosinni) Preparation, role of different media constituents and natural extracts.
1.4 Cellular Differentiation and Totipotency.

UNIT-2:

2.1 Micropropagation- Introduction, advantages and limitations.
2.2 Micropropagation (Direct organogenesis).
2.3 Micropropagation (Indirect organogenesis).

UNIT-3:

3.1 *In vitro* Embryogenesis: Somatic and Zygotic embryo culture conditions and practical applications.
3.2 Synthetic seeds – Classification, Encapsulation, Advantages limitations and Applications.
3.3 Cryopreservation and Germplasm conservation.

UNIT-4:

4.1 Haploid Production- Anther, Pollen, Ovary and Ovule Culture.
4.2 Factors affecting androgenesis and gynogenesis, Applications and Limitations.
4.3 Protoplast isolation and Culture-Methods of Isolation, Factors affecting Isolation, Purification and steps involved in culture.
4.4 Single cell culture.

4. Course Learning Outcomes/Students' Learning Outcomes (SLO)

UNIT	SLO
1	Students will learn about historical perspective of plant tissue culture, plant tissue culture laboratory requirements and basic plant tissue culture media preparation and its significance.
2	Whole unit focuses on one of the most important method of plant tissue culture i.e. Micropropagation, its types, advantages and limitations.
3	Students will learn about types of *in vitro* embryogenesis, its culture conditions and its practical applications. They also learn about new other means of plant tissue culture i.e. synthetic seed technology and few preservation techniques.
4	The unit focuses on different tissue culture techniques for haploid plant production in detail.

5. Recommended Learning Resources

- Chawla H. Introduction to plant biotechnology (3/e). CRC Press; 2011 May 24.
- Bhojwani SS, Razdan MK. Plant tissue culture: theory and practice. Elsevier; 1986 Jul 1.
- Jha TB. Plant tissue culture: basic and applied. Universities Press; 2005.
- Veeresham C, Kokate CK. Medicinal plant biotechnology. CBS Publishers and Distributers; 2006.
- Razdan MK. Introduction To Plant Tissue Culture, 2/E. Oxford and IBH publishing; 2002.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BT-22: Animal Biotechnology

1. Course Code & Title

Course Code: BT-22 **Course Title:** Animal Biotechnology

No. of Credits:	2
Subject:	Biotechnology
Faculty:	Science
Learning Hours/Week:	2
Course Type:	Core

2. Course Overview & Course Objectives

- This course includes knowledge about techniques used in culturing of Animal cells in *in vitro* environment.
- It is designed to give basic information about Animal Biotechnology subject, use of animal cell culture methods, various laboratory Equipments and procedures.
- It gives the basic understanding of the way cell performs in the cultural environment and applications of cultured cells.
- The syllabus also focuses on different tools and techniques applied in the field of assisted reproduction and in vitro fertilization.

3. Course Content

UNIT-1: Introduction to Animal Biotechnology:

1.1 Application of animal biotechnology
1.2 Advantages and limitations of animal tissue culture
1.3 Types of tissue culture
1.4 Equipments for cell culture

UNIT-2: Biology of Cultured Cells:

2.1 Cell adhesion
2.2 Cell proliferation
2.3 Cell differentiation

UNIT-3: Aseptic Techniques and Animal Cell Culture Media:

3.1 Aseptic environment and sterile handling
3.2 Defined media – Physical properties of media, complete media and serum free media
3.3 Sterilization of media

UNIT-4: Animal Reproductive Biology:

4.1 Artificial insemination
4.2 Super ovulation
4.3 *In vitro* fertilization
4.4 Embryo transfer technology

4. Course Learning Outcomes/ Students Learning Outcomes (SLOs)

UNIT	SLO
1	• This covers an introductory part of Animal Biotechnology where students get familiar with the basics of animal cell and tissue culture also the equipments used while culturing animal cells. • The unit focuses on various advantages of studying Animal Biotechnology like – way to control the culture environment, characterization and homogenization of cultured cells etc. • One can also learn different types of Animal cell culture techniques used in laboratory like – Adherent culture, Suspension culture and many more.
2	• Students will learn the general biological features of cells inside culture environment, their behaviour, metabolism and proliferation in *in vitro* conditions. • Students gets familiar with cell – cell adhesion properties, how cells will proliferate under *in vivo* and *in vitro* conditions, how cell differentiates in variety of other forms.
3	• This unit gives training to setup an animal biotechnology laboratory. • An overview is explained here for the techniques to carry out primary and secondary cell lines. • It also covers the various types of culture media used in culturing of animal cells in *in vitro* environment like – Defined media, Complete medium, Serum free medium etc. as well as techniques used in sterilization of media – autoclaving and filter sterilization.
4	• This unit is an introductory part of Artificial Insemination and *in vitro* fertilization (IVF) technology. • Students will learn about methods used for assisted reproduction like – intra uterine sperm transfer for Artificial insemination. • The unit also covers the methods used in production of multiple egg cells used in artificial insemination technologies like IVF. • Also students can learn the techniques used for intra uterine embryo transfer as a part of assisted reproductive biology.

5. Recommended Learning Resources

- Freshney RI. Culture of animal cells: a manual of basic technique and specialized applications. John Wiley & Sons; 2015 Dec 23.
- Gordon I, editor. Reproductive technologies in farm animals. CABi; 2017 Jun 23.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY, SURAT
B. Sc. Biotechnology Semester-VI

BTP-06: Biotechnology Practical

1. **Course Code:** BTP 06
2. **Course Title:** Biotechnology Practicals
3. **Course Overview & Course Objectives**

Syllabus includes the practical aspects of major fields like bioinformatics, plant biotechnology, animal biotechnology and microbiology. The students will become familiar with the use of a wide variety of internet applications, biological database, online tools for in silico analysis and will be able to apply these methods to basic research problems. Emphasis will be given to the application of bioinformatics and biological databases to problem solving in real research problems.

Students can learn various bioinformatics tools for sequence retrieval or to study protein structure. They also learn the tissue culture techniques and basic microbiological techniques which may be associated with production of antibiotics and organic acids or determination of water contamination.

Course Objectives

- To provide basic knowledge of bioinformatics tools for sequence retrieval both for nucleotides and proteins followed by the alignment and sequence prediction respectively.
- To teach the concept of primary and secondary screening of microorganisms for the production of primary and secondary metabolites.
- To teach basic tissue culture techniques like different media preparation for in vitro establishment of various plant parts.
- To provide basic knowledge of buffers and media and to explain its importance in culture.

4. **Course Content**

1. Nucleotide and protein Sequence retrieval from NCBI/EMBL
2. Protein Structure retrieval from Protein Data Bank (PDB)
3. Exploring information from metabolic pathway database
4. Protein structure visualization by RasMol
5. Pairwise sequence alignment using BLAST/FASTA
6. Multiple sequence alignment using Clustal Omega/Clustal X
7. Sterility testing of pharmaceutical products
8. Determine MIC of commercially available antibiotics
9. Isolation and screening of antibiotic producing microorganisms:
   (a) Crowded Plate Technique (b) Wilkin's Technique
10. Isolation and screening of Extracellular enzyme producing microorganisms:
    (a) Amylase producer
    (b) Protease producer
    (c) Cellulase producer
    (d) Lipase producer
11. Fermentation by eukaryotic microorganisms:
    (a) Aerobic- Citric acid (b) Anaerobic- Ethanol

12. Isolation of antibiotic resistant mutants by GPT and RPT
13. Determination of COD and BOD of given waste water
14. Detection of faecal coliforms in drinking water by defined substrate test
15. Isolation of mesophyll cell by different methods.
16. Media preparation (Murashiage and Skoog, Gamborg B5) and explants inoculation.
17. Callus culture from different explants (node, internode and leaf).
18. Preparation of buffers and media for animal cell culture:
    (a) PBS & HBSS (b) RPMI-1640/DMEM
19. Sterilization of buffers and animal cell culture media by autoclave and filtration techniques
20. Isolation of cells from Spleen / Liver / Chick fibroblast

5. Course Learning Outcomes/Students' Learning Outcomes (SLO)

Practical	SLO
Practical 1-6 (Bioinformatics)	The major aim is to provide them basic level training in bioinformatics methods including accessing the major public sequence databases, use of the different computational tools to find sequences, perform text and sequence based searches analysis of protein and nucleic acid sequences using various software packages. Students will learn major tools of bioinformatics which may allow them to determine the degree of homology between sequences and prove helpful in predicting putative structure of proteins.
Practical 7-14 (Applied Microbiology)	Students will develop understanding related to the industrial screening and fermentation process. They will also learn the basic techniques for detection of coliforms which are associated with water contamination.
Practical 15-17 (Plant Tissue Culture)	Students will get the idea related to specific media and growth condition for the development of callus from explants.
Practical18-20 (Animal Cell Culture)	Practical skills of students will be enhanced as they learn the preparation of media for culturing animal cells, sterilization techniques and isolation of specific cells.

6. Recommended Learning Resources

- Bhojwani SS, Razdan MK. Plant tissue culture: theory and practice. Elsevier; 1986 Jul 1.
- Razdan MK. Introduction To Plant Tissue Culture, 2/E. Oxford and IBH publishing; 2002.
- Patel RJ, Patel KR. Experimental microbiology Part II. Aditya Publication, Ahmedabad. 2016.

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