

**DEPARTMENT OF BIOTECHNOLOGY
MATA GUJRI MAHILA MAHAVIDYALAYA (AUTONOMOUS)
JABALPUR**

**Syllabus prescribed for the degree of Bachelor of Science
(Academic Session 2023-24)**

**B. Sc. First Year (Sem I & Sem II)
According to New Education Policy**

Semester I

Major Course I

Course Code: Core-Th1 SI-BTE 1T (MJ)

Course Title: Cell Biology and Biochemistry

Credit- 04

Introduction			
Program: Certificate Course		Class: B.Sc.	Year : 2023
Session : 2023-2024			
Subject : Biotechnology			
1.	Course Code	Core Th-1 SI-BTE 1T (MJ)	
2.	Course Title	Cell Biology and Biochemistry	
3.	Course Type	Core Course	
4.	Pre-requisite (If any)	To study this course, a student must have had the subject biology in 12 th class	
5.	Course Learning Outcome (CLO)	Course Objective: The main objective of the course will be to build the basic foundation for studying Biotechnology. The demand for trained workforce in biotechnology is ever growing in Fundamental Research and Industry sector, Academic and Research Sector also Require Interdisciplinary trained manpower to foster the biotechnology Revolution. The restructured syllabus combines basic principles of chemical and Biological Science in light of advancements in technology. The curriculum aims to impart basic knowledge with emphasis on its application to make the student ready got industries and research work in concerned field. Learning Outcome :- At the end of the paper, a student should be able to, 1. Understand basics of cell biology 2. Appreciate the importance of bonding and spatial arrangements of molecules for proper functioning and stability. 3. Understand both the physical as well as chemical properties of the biomolecules. 4. The student could pursue a career in biochemistry testing. The decrease of increase in the amount of some of the biomolecules can have clinical significance. 5. Students can also go in for medical laboratory technique course, opening opportunities in hospitals and pathological laboratories.	
6.	Credit Value	Theory- 4	
7.	Total Marks	Max. Marks- 100(40+60)	Min Marks : 35

Part B – Content of the Course		
Total Lectures: 60 hours Total numbers of Lectures (in hours per week): 2 hours per week		
Unit	Topics	Number of Lectures
I.	Cell as a Basic Unit 1. Historical background of the cell 1.1 History of cell biology. 1.2 Cell structure. 1.3 Cell theory. 2. Prokaryotic cell and cell organelles 2.1 Ultra structure of Prokaryotic cell. 2.2 Structure and Function of Bacterial Cell- Flagella, Pili, Cell Wall, Cytoplasmic Membrane, Nuclear Region, Ribosomes, Vacuoles, Metachromatic Granules, Spores and cysts, Microtubules, Microfilaments, Centrioles. 2.3 Difference between prokaryotic and eukaryotic cell.	12
II.	Cell organelles and Cell cycle 1. Eukaryotic cell and cell organelles 1.1 Ultrastructure of Eukaryotic cell (Plant and Animal Cell) 1.2 Structure And Function of Eukaryotic Cell- Cell Wall, Cell Membrane, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi Bodies, Nucleus, Cytoskeleton, Micro bodies, Centrioles, Lysosome. 2. Cell cycle 2.1 Cell cycle and cell division. 2.2 Apoptosis and Cell death	12
III.	Molecular Structure of Water: 1. Water Structure and Buffer 1.1 Properties of water 1.2 Interaction of water 1.3 Role of water in bio molecular structure. 1.4 Acid, base and buffer. 2. Chemical Bonds: Chemical bonds: Ionic bond, Covalent bond, Non-Covalent bonds, Hydrogen bonds, Coordinate bond.	12

IV.	Biomolecules Source, Nomenclature, Classification, Structure, Characteristics and Functions of: 1. Carbohydrates, 2. Lipids, 3. Proteins and 4. Nucleic acid.	12
V.	Tools and Techniques: Principle and Application of Light Microscope, Centrifugation, Chromatography (Paper, Thin Layer and Column), Colorimeter and Spectrophotometer	12
		60

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: 1. Industrial Biotechnology- B D Singh 2. Textbook of Biochemistry- S P Singh 3. Cell and Molecular Biology –P K Gupta 4. Cell Biology – P S Verma and Agrawal 5. Cell and Molecular Biology – S C Rastogi

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Min : 35 Continuous Comprehensive Evaluation (CCE) : 40 marks Min Marks: 14 University Exam (UE): 60 marks Min Marks: 21		
Internal Assessment : Continuous Comprehensive Evaluation (CCE): 40	Class Test/ Assignment/Presentation/ Written test	20 Marks each (Best two out of three) Total:40
External Assessment : University Exam Section: 60 Time : 03.00 Hours	Section(A) : Five Objective Type Questions Section (B) : FiveShort Questions (150 words each) Section (C) : FiveLong Questions (500 words each)	5 x 01= 05 5 x 03= 15 5 x08 = 40 Total: 60

B. Sc. First Year (Semester I) Biotechnology**Course Code- CORE- PR-1-SI-BTE- 1P****Course Title- Labwork for Cell Biology and Biochemistry
Credit-02**

Part A - Introduction			
Program : Certificate Course		Class: B.Sc.	Year: First Year
Session :2024-25			
Subject: Biotechnology			
1.	Course Code	Core PR-1 SI-BTE 1T (MJ)	
2.	Course Title	Lab work for Cell Biology and Biochemistry	
3.	Course Type	Core Course	
4.	Pre-requisites	To study this course, a student must have had the subject biology in 12 th class.	
5.	Course Learning outcomes	Course objective: - The Main Objective of the course will be to give hands-on practical knowledge in Biotechnology. The demand for trained workforce in biotechnology is ever growing in fundamental research and industry sector. Academic and research sectors also require interdisciplinary trained manpower to foster the biotechnology revolution. The curriculum aims to impart basic knowledge with emphasis on its applications to make the students ready for industries and research work in concerned field. Learning outcome:- At the end of the paper , a student will be able to 1. Understand basic techniques of cell biology. 2. Know the physical as well as chemical properties of biomolecules. 3. Pursue a career in biochemical testing. The decrease of increase in the amount of some of the biomolecules can have clinical significance. 4. Take medical laboratory technique courses, opening opportunities in hospitals and pathological laboratories.	
6.	Credit Value	Practical -2	
7.	Total Marks	Max. Marks- 100 (40+60)	Min Passing Marks : 35

Part B – Content of the Practical Course	
Total Lectures in Practical : 30 hours Total numbers of Lectures (in hours per week): 2 hours per week Credits:2	
	List of Experiments/Exercise/Practicals: 1. To study the plant cell structure using various plant materials. 2. To study the animal cell structure using cheek cells. 3. To prepare onion root tip for stages of mitosis. 4. To analyze Carbohydrate qualitatively. 5. To analyze Protein qualitatively. 6. To analyze Lipids qualitatively. 7. To prepare buffers. 8. To separate plant pigments by paper chromatography. 9. To separate amino acids by TLC. 10. To prepare and study the different stages of mitosis and meiosis.

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: 1. Laboratory techniques in modern biology; N.Swarup , S.C. Pathak. , S. Arora , Kalyani publication , New Delhi. 2. Integrated methodologies in biology; Shashi Shrivastava, P. Banerjee, Arun Prakashan, Gwalior. 3. Experimental in microbiology plant pathology and Biotechnology ; K.R. Aneja, New Age International , New Delhi, 2007 4. Laboratory manual of Biotechnology; P.N. Swamy, Rastogi Publication , Meerut. 5. Manual of experiments in Biotechnology ; Leena Lakhani , Sheeba Khan , Kailash Pustak Sadan, Bhopal	

Part D - Assessment and Evaluation			
Scheme of Practical Exam			
Max Marks:100 Internal Assessment/CCE:40 External Assessment/University Exam:60			
Internal Assessment		External Assessment	
Class Interaction /Quiz	15	Viva Voce on Practical	05
Attendance		Practical Record File	05
Assignments (Charts/Model Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)	10	Major experiment	15
	15	Minor experiment -1	10
		Minor experiment-2	10
		Spotting	15
Total	40 Marks		60 Marks

B. Sc. First Year (Semester II) Biotechnology

Semester II

Major Course II

Course Code: Core-Th1 S2-BTE 1T (MJ)

Course Title: Microbiology and Immunology

Credit- 04

Introduction			
Program: Certificate Course		Class: B.Sc	Year : 2023
Session : 2023-2024			
Subject : Biotechnology			
1.	Course Code	Core-Th1 S2-BTE 1T (MJ)	
2.	Course Title	Microbiology and Immunology	
3.	Course Type	Core Course	
4.	Pre-requisite (If any)	To study this course, a student must have had the subject biology in 12 th class	
5.	Course Learning Outcome (CLO)	Course Objective: To create general understanding about microbiology and immunology. 1. The student will be able to understand microbial diversity and Nutrition. 2. The students will be able to understand the immune system, immune responses and vaccination. 3. The student will be able to describe role of immune system in both maintaining health and contributing to disease. 4. The student will be able to understand immunological technique. Course Learning Outcomes: At the end of the course student will familiar with – 1. Microbial diversity and nutrition. 2. Immune system, its properties and types. 3. Immunoglobulin structure, types and functions and can apply the concept of hypersensitivity and vaccination for different diseases. 4. Perform various immunological techniques.	
6.	Credit Value	Theory- 4	
7.	Total Marks	Max. Marks-100(40+60)	Min Marks : 35

Part B – Content of the Course

Total Lectures: 60 hours Total numbers of Lectures (in hours per week): 2 hours per week		
Unit	Topics	Number of Lectures
I.	Unit-I History, Basic, Concept of Microbiology and Culture media Preparation 1. History, Basic Concept of Microbiology: 1.1 Fundamental, History and Evolution of microbiology, development of Microbiology, application of microbiology in human welfare. 1.2 Classification, general characteristic and structure of bacteria, fungi and Virus. 1 Media Preparation & Pure culture techniques: 2.1 Methods and types: Culture, minimal, selective, differential. transport media 2.2 Synchronous, batch and continuous culture. 2.3 Pure culture techniques	12
II.	Unit-II Microbial growth and growth measurement: 1 Microbial Growth: 1.1 Definition of growth, mathematical expression of growth, growth curve, generation time, growth yield, effect of nutrients on growth. 1.2 Factor affecting growth: Nutrient, temperature, Oxygen, pH, osmotic pressure. 2 Growth Measurement: 2.1 Measurement of growth (direct and indirect method): cell number, cell mass and cell activity. 2.2 Cell count: Turbid metric method, plate count method, Membrane count method, Dry weight and Wet method by measurement of cellular activity.	12
III.	Unit-III Basic of Immunology: 1 Basic of Immunology: 1.1 Concept of innate and acquired immunity, phagocytosis complement and inflammatory responses. 1.2 Immune cells and organs: Structure, Function and Properties of immune cells –Stem cell, T cell, B-Cell, NK-cell, Macrophages, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell. 1.3 Immune Organ: Bone marrow, Thymus, Lymph Node, Spleen, Lymphatic system.	12

IV.	Unit-IV Immunology and Immune Response: 1 Immunoglobulin 1.1 Antigen: characteristics of an antigen: foreignness, Molecular mass, chemical composition and heterogeneity, Antigen, Adjuvants, Epitopes, Haptens. 1.2 Antibodies: Structure, types, Functions and properties of antibodies, antigenic determinants and antibodies (Isotypic, Allotypic, Idiotypic) Monoclonal and polyclonal and chimeric antibodies). 2 Immune Response: Generation of immune response: Primary and Secondary immune Response, generation of humoral response (plasma and memory cell), Generation of cell mediate immune response (self MHC restriction, T- cell activation, Co-stimulatory signals),Killing mechanisms by CTL and NK cells, Introduction to tolerance	12
V.	Unit-V Microbial, Immunological, Techniques and Vaccination 1 Microbial Techniques: 1.1 Principle, working and application of instruments- Laminar airflow, Autoclave, Hot air oven. 2 Immunological Techniques: 2.1 RIA, ELISA, western blotting, principle of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis. 3 Vaccination: 3.1 Vaccines and Vaccination: Rubella, Varicella (Chickenpox),polio, Diptheria, Hepatitis Vaccine, Corona Vaccine	12
		60

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: 1. Cell and Molecular Biology by P. K. Gupta 2. Cell and Molecular Biology by S.C. Rastogy 3. Molecular Biology of cell by Albertset.al. 4. Cell Biology by P S Verma and Agarwal 5. Textbook of Microbiology by R.C Dubey 6. A Textbook of Microbiology by Dubey and Maheshwari 7. Essentials of Microbiology by K.S Bilgrami R.K Sinha 8. Microbiology by P D Sharma 9. General Microbiology Vol I & II by Pawar&Daginawala 10. Applied Microbiology by P.D Sharma 11. Microbiology Fundamentals & Applications by S.S Purohit 12. Experiments in Microbiology, Plant Pathology and Biotechnology by K.R Aneja 13. Fundamentals of Microbiology & Immunology by A.K Banerjee, Nirmalaya Banerjee 14. Modern Concept of Microbiology by H D Kumar & Swati Kumar 15. Textbook of Microbiology by R.P Singh 16. Immunology- K R Joshi 17. Introduction to Biotechnology: Expanding Horizons by B.D Singh

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Min : 35 Continuous Comprehensive Evaluation (CCE) : 40 marks Min Marks: 14 University Exam (UE): 60 marks Min Marks: 21		
Internal Assessment : Continuous Comprehensive Evaluation (CCE): 40	Class Test/ Assignment/Presentation/ Written test	20 Marks each (Best two out of three) Total:40
External Assessment : University Exam Section: 60 Time : 03.00 Hours	Section(A) : Five Objective Type Questions Section (B) : Five Short Questions (150 words each) Section (C) : Five Long Questions (500 words each)	5 x 01= 05 5 x 03= 15 5 x 08 = 40 Total: 60

B. Sc. First Year (Semester II) Biotechnology

Semester II

Major Course II

Course Code: Core-Pr1 S2-BTE 1P (MJ)

Course Title: Labwork for Microbiology and Immunology

Credit- 02

Part A - Introduction			
Program : Certificate Course		Class: B.Sc.	Year: First Year Sem: II
Session :2023-24			
Subject: Biotechnology			
1.	Course Code	Core-Pr1 S2-BTE 1P (MJ)	
2.	Course Title	Labwork for Microbiology and Immunology	
3.	Course Type	Major-II Core Course	
4.	Pre-requisites	To study this course, a student must have had the subject biology in 12 th class.	
5.	Course Learning outcomes	Course objective: The objective of the course is to prepare students competent in subject through in-depth lecture and laboratory practices- 1. The students will be able to identify microbes using modern techniques. 2. The students will acquire skill and competence in microbiological and immunological laboratory practices applicable to microbiological research or clinical methods of immunology , including accurately reporting observation and analysis. Course Learning outcome On completion of this course , learners will be able to have sufficient scientific understanding of microbiology and immunology - Students apply concept, principle and types of sterilization methods viz performing microbiology experiments . Students apply the concept and characteristics of antiseptic, disinfected and their mode of action in day to day life . Students will apply principle, working and applications of instruments-Laminar airflow, Autoclave , Hot air oven etc.	
6.	Credit Value	Practical -2	
7.	Total Marks	Max. Marks-100 (40+60)	Min Passing Marks : 35

Part B – Content of the Practical Course

Total Lectures in Practical : 30 hours

Total numbers of Lectures (in hours per week): 2 hours per week

Credits:2

List of Experiments/Exercise/Practicals:

- 1 To perform Aseptic technique, cleaning of glasswares, preparation of cotton plug and sterilization.
- 2 To prepare bacterial and fungal media.
- 3 To isolate microbes from Air, water and soil.
- 4 To study dilution and plating by pour plate and spread plate methods.
- 5 To study Gram staining, endospore staining and fungal staining algal staining.
- 6 To identify bacteria based on staining, shape and size.
- 7 To enumerate Microorganism – Total and Viable Count.
- 8 To study Antibiotic Sensitivity of microbes by the use of antibiotic discs.
- 9 To isolate and identify bacteria from sewage and wastewater
- 10 To determine the growth curve and generation time of *E.coli*.
- 11 To perform blood group analysis.
- 12 To enumerate the total WBC/ RBC of the given blood sample by Hemocytometer.
- 13 To enumerate differential Leukocytes of the given blood sample.
- 14** To isolate and identify aquatic Fungi and local water bodies.
- 15 To measure pH of given water and soil samples.

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: - Laboratory techniques in modern biology; N.Swarup , S.C. Pathak. , S. Arora , Kalyani publication , New Delhi. - Integrated methodologies in biology; Shashi Shrivastava, P. Banerjee, Arun Prakashan, Gwalior. - Experimental in microbiology plant pathology and Biotechnology ; K.R. Anejaa, New Age International , New Delhi, 2007 - Laboratory manual of Biotechnology; P.N. Swamy, Rastogi Publication , Meerut. - Practical microbiology ; R.C. Dubey , D.K. Maheshwari , S. Chand & Company, Delhi. - Manual of experiments in Biotechnology ; Leena Lakhani , Sheeba Khan , Kailash Pustak Sadan, Bhopal	

Part D - Assessment and Evaluation			
Scheme of Practical Exam			
Max Marks:100 Internal Assesment/CCE:40 External Assesment/University Exam:60			
Internal Assessment	15	External Assessment	
Class Interaction /Quiz		Viva Voce on Practical	05
Attendance	10	Practical Record File	05
Assignments (Charts/Model Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)	15	Major experiment	15
		Minor experiment -1	10
		Minor experiment-2	10
		Spotting	15
Total	40 Marks		60 Marks

B. Sc. First Year (Semester I) Biotechnology

Semester I

Minor Course I

Course Code: S1-BTE 2T (MN)

Course Title: Microbiology

Credit- 04

Introduction			
Program: Certificate Course		Class: B.Sc	Year : 2023
Session : 2023-2024			
Subject : Biotechnology			
1.	Course Code	S1-BTE 2T (MN)	
2.	Course Title	Microbiology	
3.	Course Type	Minor Course	
4.	Pre-requisite (If any)	To study this course, a student must have had the subject biology in 12 th class	
5.	Course Learning Outcome (CLO)	Course Objective: To create general understanding about microbiology. The student will be able to understand microbial diversity and Nutrition. The students will be able to understand the pure culture techniques The student will be able to describe role of microorganisms in both maintaining health and contributing to disease. The student will be able to understand microbiological techniques. Course Learning Outcomes: At the end of the course student will familiar with – Microbial diversity and nutrition. Different types of microbes. Role of microorganisms in different areas Perform various microbiological techniques.	
6.	Credit Value	Theory- 4	
7.	Total Marks	Max. Marks-100(40+60)	Min Marks : 35

Part B – Content of the Course		
Total Lectures: 60 hours Total numbers of Lectures (in hours per week): 2 hours per week		
Unit	Topics	Number of Lectures
I.	Unit-I History, Basic Concept of Microbiology: Fundamental, History and Evolution of microbiology, development of Microbiology, application of microbiology in human welfare. Classification, general characteristic and structure of bacteria, fungi and Virus.	12
II.	Media Preparation, Sterilisation & Pure culture techniques: Methods and types: Culture, minimal, selective, differential. transport media Synchronous, batch and continuous culture. Pure culture techniques: Serial Dilution Method, Spread plate, Pour plate & Streak plate methods	12
III.	Unit-II Control of Microorganisms and methods of staining Simple, Gram staining, endospore staining, Capsule, Flagella, and Negative Staining, Fungal Stains, algal stains. Control of Microorganisms: physical and chemical evaluation of chemical disinfectants, tube dilution test, agar diffusion test and phenol-coefficient Biosafety Rules and Regulation	12
IV.	Unit-IV Microbial growth and growth measurement: Microbial Growth: Definition of growth, mathematical expression of growth, growth curve, generation time, growth yield, effect of nutrients on growth. Factor affecting growth: Nutrient, temperature, Oxygen, pH, osmotic pressure. Growth Measurement: Direct and indirect method of Measurement of growth: Cell count by Turbid metric method, plate count method, Membrane count method, Dry weight and Wet method by measurement of cellular activity.	12
V.	Unit-V Microbial Techniques Principle, working and application of instruments like Laminar airflow, Autoclave, Hot air oven, Incubator, spectrophotometer Microbial metabolism- Concepts of Anabolism and Catabolism , Microbial diseases in Human, plants, and Animals.	12
		60

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: 1. Cell and Molecular Biology by P. K. Gupta 2. Cell and Molecular Biology by S.C. Rastogy 3. Molecular Biology of cell by Albertset.al. 4. Cell Biology by P S Verma and Agarwal 5. Textbook of Microbiology by R.C Dubey 6. A Textbook of Microbiology by Dubey and Maheshwari 7. Essentials of Microbiology by K.S Bilgrami R.K Sinha 8. Microbiology by P D Sharma 9. General Microbiology Vol I & II by Pawar&Daginawala 10. Applied Microbiology by P.D Sharma 11. Microbiology Fundamentals & Applications by S.S Purohit 12. Experiments in Microbiology, Plant Pathology and Biotechnology by K.R Aneja 13. Fundamentals of Microbiology & Immunology by A.K Banerjee, Nirmalaya Banerjee 14. Modern Concept of Microbiology by H D Kumar & Swati Kumar 15. Textbook of Microbiology by R.P Singh

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Min : 35 Continuous Comprehensive Evaluation (CCE) : 40 marks Min Marks: 14 University Exam (UE): 60 marks Min Marks: 21		
Internal Assessment : Continuous Comprehensive Evaluation (CCE): 40	Class Test/ Assignment/Presentation/ Written test	20 Marks each (Best two out of three) Total:40
External Assessment : University Exam Section: 60 Time : 03.00 Hours	Section(A) : Five Objective Type Questions Section (B) : FiveShort Questions (150 words each) Section (C) : Five Long Questions (500 words each)	5 x 01= 05 5 x 03= 15 5 x08 = 40 Total: 60

B. Sc. First Year (Semester II) Biotechnology

Semester I

Minor Course I

Course Code: Core-Pr1 S1-BTE 2P (MN)

Course Title: Labwork for Microbiology

Credit- 02

Part A - Introduction			
Program : Certificate Course		Class: B.Sc.	Year: First Year Sem: II
Session :2023-24			
Subject: Biotechnology			
1.	Course Code	Core-Pr1 S1-BTE 2P (MN)	
2.	Course Title	Labwork for Microbiology	
3.	Course Type	Minor I Course	
4.	Pre-requisites	To study this course, a student must have had the subject biology in 12 th class.	
5.	Course Learning outcomes	Course objective: The objective of the course is to prepare students competent in subject through in-depth lecture and laboratory practices- The students will be able to identify microbes using modern techniques. The students will acquire skill and competence in microbiological and immunological laboratory practices applicable to microbiological research or clinical methods of immunology , including accurately reporting observation and analysis. Course Learning outcome On completion of this course , learners will be able to have sufficient scientific understanding of microbiology Students apply concept, principle and types of sterilization methods viz performing microbiology experiments . Students apply the concept and characteristics of antiseptic, disinfected and their mode of action in day to day life . Students will apply principle, working and applications of instruments-Laminar airflow, Autoclave , Hot air oven etc.	
6.	Credit Value	Practical -2	
7.	Total Marks	Max. Marks-100 (40+60)	Min Passing Marks : 35

Part B – Content of the Practical Course	
Total Lectures in Practical : 30 hours Total numbers of Lectures (in hours per week): 2 hours per week Credits:2	
	List of Experiments/Exercise/Practicals: 1 To perform Aseptic technique, cleaning of glass wares, preparation of cotton plug and sterilization. 2 To prepare bacterial and fungal media. 3 To study principle, working and applications of instruments-Laminar airflow, Autoclave , Hot air oven, Incubator etc. 4 To isolate microbes from Air, water and soil. 5 To study dilution and plating by pour plate and spread plate methods. 6 To perform simple staining, Gram staining, endospore staining and fungal staining 7 To identify bacteria based on staining, shape and size. 8 To enumerate Microorganism – Total and Viable Count. 9 To study Antibiotic Sensitivity of microbes by the use of antibiotic discs. 10 To isolate and identify bacteria from sewage and wastewater 11 To determine the growth curve and generation time of <i>E.coli</i>. 12 To isolate and identify aquatic Fungi and local water bodies. 13 To measure pH of given water and soil samples.

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: - Laboratory techniques in modern biology; N.Swarup , S.C. Pathak. , S. Arora , Kalyani publication , New Delhi. - Integrated methodologies in biology; Shashi Shrivastava, P. Banerjee, Arun Prakashan, Gwalior. - Experimental in microbiology plant pathology and Biotechnology ; K.R. Anejaa, New Age International , New Delhi, 2007 - Laboratory manual of Biotechnology; P.N. Swamy, Rastogi Publication , Meerut. - Practical microbiology ; R.C. Dubey , D.K. Maheshwari , S. Chand & Company, Delhi. - Manual of experiments in Biotechnology ; Leena Lakhani , Sheeba Khan , Kailash Pustak Sadan, Bhopal	

B. Sc. First Year (Semester II) Biotechnology

Semester II

Minor Course II

Course Code: S2-BTE 2T (MN)

Course Title: Immunology

Credit- 04

Introduction			
Program: Certificate Course		Class: B.Sc	Year : 2023
Session : 2023-2024			
Subject : Biotechnology			
1.	Course Code	S2-BTE 2T (MN)	
2.	Course Title	Immunology	
3.	Course Type	Minor Course	
4.	Pre-requisite (If any)	To study this course, a student must have had the subject biology in 12 th class	
5.	Course Learning Outcome (CLO)	Course Objective: To create general understanding about microbiology and immunology. 1. The students will be able to understand the immune system, immune responses and vaccination. 2. The student will be able to describe role of immune system in both maintaining health and contributing to disease. 3. The student will be able to understand immunological technique. Course Learning Outcomes: At the end of the course student will familiar with – 1. Immune system, its properties and types. 2. Immunoglobulin structure, types and functions and can apply the concept of hypersensitivity and vaccination for different diseases. 3. Perform various immunological techniques.	
6.	Credit Value	Theory- 4	
7.	Total Marks	Max. Marks-100(40+60)	Min Marks : 35

Part B – Content of the Course		
Total Lectures: 60 hours Total numbers of Lectures (in hours per week): 2 hours per week		
Unit	Topics	Number of Lectures
I.	Unit-I Basic of Immunology: Basic of Immunology: Concept of innate and acquired immunity, phagocytosis complement and inflammatory responses. Immune cells: Structure, Function and Properties of immune cells –Stem cell, T cell, B-Cell, NK-cell, Macrophages, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell.	12
II.	Unit-II Immune Organ: Primary & Secondary Lymphoid organs: Bone marrow, Thymus, Lymph Node, Spleen, Lymphatic system. Major Histocompatibility Complex, BCR & TCR	12
III.	1 Unit-III Immunoglobulin Antigen: characteristics of an antigen: foreignness, Molecular mass, chemical composition and heterogeneity, Antigen, Adjuvants, Epitopes, Antibodies: Structure, types, Functions and properties of antibodies, antigenic determinants and antibodies (Isotypic, Allotypic, Idiotypic) Monoclonal and polyclonal antibodies.	12
IV.	Unit-IV Immunology and Immune Response: Immune Response: Generation of immune response: Primary and Secondary immune Response, generation of humoral response (plasma and memory cell), Generation of cell mediate immune response (self MHC restriction, T- cell activation, Co-stimulatory signals),Killing mechanisms by CTL and NK cells, Introduction to tolerance	12
V.	Unit-V Immunological, Techniques and Vaccination Immunological Techniques& serological reactions: RIA, ELISA, western blotting, principle of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis. Vaccination: Vaccines and Vaccination: Rubella, Varicella (Chickenpox),polio, Diptheria, Hepatitis Vaccine, Corona Vaccine	12
		60

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: 1. Textbook of Microbiology by R.P Singh 2. Immunology- K R Joshi 3. Introduction to Biotechnology: Expanding Horizons by B.D Singh 4. Immunology by Kuby 5. Roitts Immunology

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Min : 35 Continuous Comprehensive Evaluation (CCE) : 40 marks Min Marks: 14 University Exam (UE): 60 marks Min Marks: 21		
Internal Assessment : Continuous Comprehensive Evaluation (CCE): 40	Class Test/ Assignment/Presentation/ Written test	20 Marks each (Best two out of three) Total:40
External Assessment : University Exam Section: 60 Time : 03.00 Hours	Section(A) : Five Objective Type Questions Section (B) : FiveShort Questions (150 words each) Section (C) : Five Long Questions (500 words each)	5 x 01= 05 5 x 03= 15 5 x08 = 40 Total: 60

B. Sc. First Year (Semester II) Biotechnology

Semester II

Minor Course II

Course Code: S2-BTE 2P (MN)

Course Title: Labwork for Immunology

Credit- 02

Part A - Introduction			
Program : Certificate Course		Class: B.Sc.	Year: First Year Sem: II
Session :2023-24			
Subject: Biotechnology			
1.	Course Code	Core-Pr1 S2-BTE 1P (MJ)	
2.	Course Title	Labwork for Immunology	
3.	Course Type	Minor-II Course	
4.	Pre-requisites	To study this course, a student must have had the subject biology in 12 th class.	
5.	Course Learning outcomes	Course objective: The objective of the course is to prepare students competent in subject through in-depth lecture and laboratory practices- The students will acquire skill and competence in immunological laboratory practices applicable to research and clinical methods of immunology , including accurately reporting observation and analysis. Course Learning outcome On completion of this course, learners will be able to have sufficient scientific understanding of microbiology and immunology Students apply concept. Students apply the concept and characteristics of antiseptic, disinfected and their mode of action in day to day life .	
6.	Credit Value	Practical -2	
7.	Total Marks	Max. Marks-100 (40+60)	Min Passing Marks : 35

Part B – Content of the Practical Course	
Total Lectures in Practical : 30 hours Total numbers of Lectures (in hours per week): 2 hours per week Credits:2	
	List of Experiments/Exercise/Practicals: 1 To perform blood group analysis. 2 To enumerate the total WBC/ RBC of the given blood sample by Hemocytometer. 3 To perform Sandwich DOT ELISA of given sample 4 To perform Widal test of given blood sample 5 To study blood film preparation and identification of cells.

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: - Laboratory techniques in modern biology; N.Swarup , S.C. Pathak. , S. Arora , Kalyani publication , New Delhi. - Integrated methodologies in biology; Shashi Shrivastava, P. Banerjee, Arun Prakashan, Gwalior. - Experimental in microbiology plant pathology and Biotechnology ; K.R. Anejaa, New Age International , New Delhi, 2007 - Laboratory manual of Biotechnology; P.N. Swamy, Rastogi Publication , Meerut.	

Part D - Assessment and Evaluation			
Scheme of Practical Exam			
Max Marks:100 Internal Assesment/CCE:40 External Assesment/University Exam:60			
Internal Assessment		External Assessment	
Class Interaction /Quiz	15	Viva Voce on Practical	05
Attendance		Practical Record File	05
Assignments (Charts/Model Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)	10	Major experiment	15
	15	Minor experiment -1	10
		Minor experiment-2	10
		Spotting	15
Total	40 Marks		60 Marks

B.Sc. Second Year Biotechnology

Major Course I

Course Code: S2-BTE C1 T

Course Title: Basic Molecular Biology

Credit- 04

Part A - Introduction			
Program : Diploma Course		Class: B.Sc.	Year: Second Year
Session :2022-23			
Subject: Biotechnology			
1.	Course Code	S2-BTEC1T	
2.	Course Title	Basic Molecular Biology	
3.	Course Type	Major- 1 Core Course	
4.	Pre-requisites	To study this course a student must have the subject Biotechnology in certificate course.	
5.	Course Learning outcomes	1. Students will be able to explain the role of different protein/ enzymes involved in cell signalling. 2. They will be able to understand the mechanism of genetic damage caused by mutation and the role of various repair systems in neglecting the effect of these mutations. 3. Students will be able to explain mechanism of DNA replication, transcription, translation and other related processes	
6.	Credit Value	Theory- 4	
7.	Total Marks	Max. Marks-30+70	Min Marks : 33

Part B – Content of the Course		
Total Lectures: 60 hours Total numbers of Lectures (in hours per week): 2 hours per week		
Unit	Topics	Number of Lectures
I.	Genome organization: Anatomy of gene, gene structure of prokaryotes and eukaryotes. Flow of genetic information . Experimental proof for DNA as genetic material. Eukaryotic chromosome organization (Euchromatin & heterochromatin), Introduction to epigenetics	12
II.	Replication: Prokaryotic and Eukaryotic replication: models for replication, Unit of replication, replication initiation, elongation and termination, replication inhibitors Mutation: Types and causes, Mutagens and their mechanism. DNA repair: Direct reversal, Excision repair -nucleotide and base excision, Mismatch repair Trans lesion DNA synthesis, Recombination repair, SOS Response	12
III.	Transcription: Prokaryotic and Eukaryotic transcription: RNA polymerases, General and specific transcription factors, Promoters, insulator, repressor, enhancer. Translation: Prokaryotic and eukaryotic translation: Translation machinery, initiation, elongation and termination factors, translational inhibitors.	12
IV.	Biology of Cancer: Oncogenes, Tumor suppressor genes, Cancer and the cell cycle; Apoptosis, Necrosis. Cell signalling: Hormones and their receptors, second messengers, signalling through G protein coupled receptors	12
V.	Control of gene expression in Prokaryotes: DNA binding proteins, posttranscriptional control of gene expression. Gene regulation in Bacteria, Gene silencing, Overview of ribozyme technology Control of gene expression in Eukaryotes: enhancers, chromatin remodeling	12
		60

Part C - Learning Resources
Text Books, Reference Books, Other Resources
Suggested Readings: 1. Molecular Biotechnology, Channarayappa. 2. Lewin's Gene XII -J. E. Kerb's, Jones and Barlett. 3. Molecular Cell Biology -H. Lodish, et.al., W H Freeman & Co (Sd), 2016, 8th edition 4. Cell Biology -G. Karp, Wiley, 2013, 7th edition 5. Molecular Biology of Cell-B. Alberts and A, Johnson, Garland Sciences, 2014 6. Molecular Biology, P. K. Gutpa. 7. Biotechnology-B.D. Singh 8. Biotechnology-U. Satyanaraynan 9. Books published by M.P. Hindi Granth Academy, Bhopal http://www.mphindigranthacademy.org

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE): 30	Class Test Assignment/Presentation	Total 30
External Assessment : University Exam Section: 70 Time : 03.00 Hours	Section(A) : Objective Type Questions Section (B) : Short Questions Section (C) : Long Questions	5 x 01= 05 5 x 05= 25 5 x 08 = 40 Total 70

Part A - Introduction			
Program : Diploma Course		Class: B.Sc.	Year: Second Year
Session :2022-23			
Subject: Biotechnology			
1.	Course Code	S2-BTEC1P	
2.	Course Title	Lab work for Basic Molecular Biology	
3.	Course Type	Major-1 Core Course	
4.	Pre-requisites	To study this course a student must have the subject Biotechnology in certificate course.	
5.	Course Learning outcomes	1. Students will be able to explain the role of different protein/ enzymes involved in cell signalling. 2. They will be able to understand the mechanism of genetic damage caused by mutation and the role of various repair system in neglecting the effect of these mutation. 3. Students will be able to explain mechanism of DNA replication, transcription, translation and other related processes	
6.	Credit Value	2	
7.	Total Marks	Max. Marks-30+70	Min Passing Marks : 33

Part B – Content of the Practical Course	
Total Lectures: 30 Total numbers of Lectures (in hours per week): 2 hours per week	
	List of Experiments/Exercise/Practicals: 1. To study isolation of genomic DNA from bacteria/fungi. 2. To study isolation of Plasmid DNA from bacteria. 3. To perform Electrophoresis of DNA-linear, circular and supercoiled plasmid. 4. To study visualization of DNA with EtBr using transilluminator/Gel Documentation system. 5. Quantification of DNA using UV/VIS spectrophotometer 6. To study Plasmid restriction map. 7. To study Effect of UV on microbial cells.

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
1. Laboratory manual of Biotechnology by P.N. Swamy, Rastogi Publication, Merrut. 2. Manual of Experiment in Biotechnology by Leera Lakhaw, Sheeba Khan, Kailash Pustak Sadan Bhopal. 3. Biotechnology –A lab project in molecular biology by Thiel, Bissen, Lyone. TATA Mc Grow Hill. 4. Molecular Biology Principles and practices by Siwach and Singh. 5. Books published by M.P. Hindi Granth Academy, Bhopal http://www.mphindigranthacademy.org/	

Part D - Assessment and Evaluation			
Scheme of Practical Exam			
Internal Assessment	30 Marks	External Assessment	70 Marks
Class Interaction /Quiz		Viva Voce on Practical	10
Attendance		Practical Record File	10
Assignments (Charts/Model		Major experiment	15
Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)		Minor experiment -1	10
		Minor experiment-2	10
		Spotting	15

B.Sc. Second Year Biotechnology**Major-2 / Minor/ Elective- Core Course****Course Code: S2-BTE C2 T****Course Title: Recombinant DNA Technology****Credit- 04**

Part A Introduction				
Program: Diploma Course		Class : B.Sc.	Year: Second	Session: 2023-24
Subject: Biotechnology				
1	Course Code	S2-BTE C2 T		
2	Course Title	Recombinant DNA Technology		
3	Course Type	Major-2 / Minor/ Elective- Core Course		
4	Pre-requisites (if any)	To study this course a student must have the subject Biotechnology in a certificate course.		
5	Course Learning outcomes (CLO)	1. The objectives of this course are to teach students with various approaches to conduct genetic engineering and their applications in biological research as well as in biotechnology industries. 2. Genetic engineering is a technology that has been developed based on our fundamental understanding of the principles of molecular biology and this is reflected in the contents of this course. 3. Given the impact of genetic engineering in modern society, the students should be endowed with strong theoretical knowledge of this technology. 4. In conjunction with the practicals in molecular biology and genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry		
6	Credit Value	Theory- 4		
7	Total Marks	Max. Marks-30+70		Min Marks : 33

Part B – Content of the Course		
Total Lectures: 60 hours		
Total numbers of Lectures (in hours per week): 2 hours per week		
Unit	Topics	Numbers of Lecture
I	The Basic Principles of Gene Cloning and DNA Analysis:- Introduction, History, The advent and importance of gene cloning, Gene amplification and PCR , Purification of DNA from Living Cells, Manipulation of Purified DNA, Introduction of DNA into Living Cells, Plasmids	12
II	Vectors for Cloning:- Cloning Vectors: PBR 322, Bacteriophage, Cosmid, Phagemid, Shuttle vectors. Cloning Vectors for E. coli, λ and other high capacity vectors, Cloning Vectors for Eukaryotes, Genomics & cDNA Libraries	12
III	Enzymology of genetic manipulation:- Enzymes useful in molecular cloning: Restriction endonuclease, DNA ligases, polynucleotide kinase, Klenow enzyme, DNA Polymerase I, reverse transcriptase, alkaline phosphatase, terminal nucleotidyltransferase	12
IV	Gene editing:- Gene Recombination and Gene transfer : DNA recombination: Models for recombination, Enzymes and proteins involved in recombination, Site-specific recombination Bacterial Conjugation, Transformation, Transduction Gene transfer techniques: Approaches, gene silencing, Mutagenesis: random, site directed, Knock-in, Knock-out	12
V	Applications and Techniques of Gene Cloning :- Real Time PCR / qPCR , Labeling nucleic acids and blotting techniques (Southern, Northern, Western, Zooblot), DNA Sequencing, DNA Fingerprinting, Applications of recombinant DNA technologies- Agriculture, Medicine, health	12
	TOTAL	60

Part C - Learning Resources	
Text Books, Reference Books, Other resources	
Suggested Readings: 1. TextBook of Biotechnology - By H.K. Das (Wiley Publications) 2. Test Book of Molecular Biology - By K.S. Sastry, G. Padmanabhan& C. Subramanyan, Publ: Macmillan India 3. Genes - By B. Lewin - Oxford Univ. Press 4. Molecular Biology & Biotechnol. - By H.D. Kumar, Publ: Vikas 5. Molecular Biology - By D. Freifelder, Publ: Narosa 6. Gene, Genomics and Genetic Engineering - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications) 7. Advanced Biotechnology- R. C. Dubey Books published by M.P. Hindi Granth Academy, Bhopal 8. Books published by M.P. Hindi Granth Academy, Bhopal http://www.mphindigranthacademy.org/	

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE):30	Class Test Assignment/Presentation	Total 30
External Assessment : University Exam Section: 70 Time : 03.00 Hours	Section(A) : Objective Type Questions Section (B) : Short Questions Section (C) : Long Questions	Total 70

B.Sc. Second Year Biotechnology

Major-2 / Minor/ Elective- Core Course

Course CodeS2- BTEC2P

Course Title: Labwork for Recombinant DNA Technology

Credit- 04

Part A			
Introduction			
Program: Diploma Course	Class : B.Sc.	Year: Second	Session: 2022-23
Subject: Biotechnology			
1	Course Code	S2-BTEC2P	
2	Course Title	Lab work for Recombinant DNA Technology	
3	Course Type	Major-2 / Minor/ Elective -Core Course	
4	Pre-requisites (if any)	To study this course a student must have the subject Biotechnology in a certificate course.	
5	Course Learning outcomes (CLO)	1. The objectives of this course are to teach students with various approaches to conduct genetic engineering and their applications in biological research as well as in biotechnology industries. 2. Genetic engineering is a technology that has been developed based on our fundamental understanding of the principles of molecular biology and this is reflected in the contents of this course. 3. Given the impact of genetic engineering in modern society, the students should be endowed with strong theoretical knowledge of this technology. 4. In conjunction with the practicals in molecular biology and genetic engineering, the students should be able to take up biological research as well as placement in the relevant biotech industry	
6	Credit Value	2	
7	Total Marks	Max. Marks-30+70	Min Passing Marks : 33

Part B – Content of the Practical Course	
Total Lectures: 30 Total numbers of Lectures (in hours per week): 2 hours per week	
	List of Experiments/Exercise/Practicals: 1. To study Isolation of DNA from plant and blood sample/animal tissue. 2. Demonstration of Polymerase Chain Reaction 3. Bacterial Transformation (Selection of transformants with blue white selection). 4. Demonstration of southern blotting. 5. Demonstration of Restriction digestion of DNA 6. Demonstration of conjugation. 7. Demonstration of Transduction.
Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
1. Molecular Biology and Biotechnology- By H.D. Kumar, Vikas Publication. 2. Gene, Genomics and Genetic Engineering- By Irfan Khan and Atiya Khanum, Ukaaz Publication. 3. Advanced Biotechnology- By R. C. Dubey 4. Introductory Practical Biochemistry - By Sawheny and Singh, Narosa Publication. 5. Biochemistry A lab manual- By Farrell and Taylor, Cengage Learning. 6. Laboratory manual on Biotechnology- By Swamy, Rastogi Publication. 7. Practical Microbiology- By Dubey and Maheshwari, S. Chand and Co. 8. Trends in Molecular Biology and Biotechnology, - By Srivastava, Srivastava and Tiwari, CBS Publication, Dehradun. 9. Books published by M.P. Hindi Granth Academy, Bhopal http://www.mphindigranthacademy.org/	

Part D - Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz		Viva Voce on Practical	
Attendance		Practical Record File	
Assignments (Charts/Model Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial Visit)		Table work/ Experiments	
TOTAL	30		70

B. Sc. Third Year**Major Course I** Discipline specific elective I (Theory) (Group A paper I)**Course Code:** S3-BTEC1D**Course Title:** Industrial Biotechnology**Credit- 04**

Part A - Introduction		
Program:Degree Class: B.Sc. Year: III Year Session :2023-24		
Subject: Biotechnology		
1.	Course Code	S3-BTEC1D
2 .	Course Title	Industrial Biotechnology
3 .	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective /Vocational/)	Discipline specific elective I (Theory) (Group A paper I)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. Student will get concept of industrial and human beneficial living organism, their exploitation and application. 2. Student will get insight on industrially important organism, recent development in fermentation processes and various optimization strategies at fermenter level. 3. Create interest about design, types of fermenter and various critical components of bioreactors.
6 .	Credit Value	4
7 .	Total Marks	Max.Marks-30+70 Min. Passing Marks: 35

Part B- Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (1 Hour Each)
I.	Discovery, classifications and nomenclature of enzymes; Physico chemical characterization of enzymes; Enzyme kinetics: Enzyme catalysis in solution kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences. Kinetics of enzyme inhibition	12
II.	Immobilization of enzymes: principle and mechanism: Mechanism of enzyme function and reactions in process techniques; Enzymatic bioconversions e.g. starch and sugar conversion processes; High Fructose Corn Syrup; Interesterified fat; Hydrolyzed protein etc. and their downstream processing; baking by amylases, deoxygenation and desugaring by glucoses oxidase, beer mashing and chill proofing; cheese making by proteases and various other enzyme catalytic actions in food processing.	12
III.	Bioprocess technology: Basic principles in bioprocess technology; Media Formulation; Sterilization; Thermal death kinetics; Batch and continuous sterilization systems; Primary and secondary metabolites; Extracellular enzymes; Biotechnologically important intracellular products; exopolymers;	12
IV.	Bioreactor designs: Types of fermentation and fermenters; Concepts of basic modes of fermentation Batch, fed batch and continuous; Conventional fermentation v/s biotransformation; Solid substrate, surface and submerged fermentation; Fermentation economics; Fermentation media; Fermenter design - mechanically agitated; Pneumatic and hydrodynamic fermenters; Large scale animal and plant cell cultivation and air sterilization; Upstream processing: Media formulation; Sterilization; Aeration and agitation in bioprocess; Measurement and control of bioprocess parameters; Scale up and scale down process.	12
V.	Techniques of enzyme isolation, purification and enzyme assay, techniques used for the immobilization of enzymes, Applications of immobilized enzyme in Biotechnology; Bioprocess control and monitoring variables such as temperature, agitation, pressure, pH Microbial processes production, optimization, screening, strain improvement, factors affecting downstream processing and recovery; Representative examples of ethanol, organic acids, antibiotics etc.	12

Part C - Learning Resources		
Text Books, Reference Books, Other Resources		
Suggested Readings: 1. Martin F. Chaplin and Christopher Bucke; Enzyme Technology, Cambridge, Univ Press 2. Anil Kumar and Sarika Garg; Enzymes and Enzyme Technology, Anshan Publishing; 1st edition 3. Jackson AT., Bioprocess in Biotechnology, Prentice Hall, Engelwood cliffs, 1991 4. Shutler ML and Kargi F., Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002. 5. Stanburry RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1977 6. Baily JE and Ollis OF., Biochemical Engineering fundamentals, 2nd edition, McGraw-Hill Book Co., New York, 1986. 7. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo Press, Tokyo 1973. 8. Young M.M., Comprehensive Biotechnology: The Principles, applications and regulations of Biotechnology in Industry, Agriculture and Medicine, Vol I, 2, 3 and 4. Reed Elsevier India Private Ltd, India, 2004. 9. Mansi EMTEL, Bryle CFA, Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor&Francis Ltd. UK 10. Books published by Madhya Pradesh Hindi Granth Acadmey, Bhopal.		
Suggestive digital platforms/web links- www.biologyonline.com		
Suggested equivalent online courses: Coursera, NPTEL, Career's 360		

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE)	Class Test Assignment/Presentation	30
External Assessment: University Exam Section Time : 03.00 Hours	Section(A) : Very Short Questions Section (B) : Short Questions Section (C) : Long Questions	70
Any remarks/suggestions:		

B. Sc. Third Year**Major Course I Discipline Specific Elective 1 (Practical)****(Group A Paper)****Course Code: S3-BTEC1Q****Course Title: Industrial biotechnology****Credit- 04**

Part A - Introduction		
Program : Degree		 Class: Year: III Session B.Sc. Year :2023-24
Subject: biotechnology		
1.	Course Code	S3-BTEC1Q
2.	Course Title	Industrial biotechnology
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective\vocational/)	Discipline Specific Elective 1 (Practical) (Group A Paper)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology-
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. Student will get concept of industrial and human beneficial living organism, their exploitation and application. 2. Student will get insight on industrially important organism, recent development in fermentation processes and various optimization strategies at fermenter level. 3. Create interest about design, types of fermenter and various critical components of bioreactors.
6.	Credit Value	2
7.	Total Marks	Max. Marks-100 Min. Passing Marks: 35

Part B - Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (2 Hours Each)
	1. Determination of oxygen transfer rate and volumetric oxygen mass transfer coefficient (KLa) under variety of operating conditions in shake flask and bioreactor. 2. Determination of mixing time and fluid flow behavior in bioreactor under variety of operating conditions. 3. Rheology of microbial cultures and biopolymers and determination of various rheological constants. 4. Production of microbial products in bioreactors. 5. Studying the kinetics of enzymatic reaction by microorganisms. 6. Production and purification of various enzymes from microbes. 7. Comparative studies of Ethanol production using different substrates. 8. Microbial production and downstream processing of an enzyme, e.g. amylase. 9. Various immobilization techniques of cells/enzymes, use of alginate for cell immobilization	.30
Keywords/ Tags:		

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: 1. Martin F. Chaplin and Christopher Bucke; Enzyme Technology, Cambridge, Univ Press 2. Anil Kumar and Sarika Garg; Enzymes and Enzyme Technology, Anshan Publishing; 1st edition 3. Jackson AT., Bioprocess in Biotechnology, Prentice Hall, Engelwood cliffs, 1991 4. Shutler ML and Kargi F., Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall, Engelwood Cliffs, 2002. 5. Stanburry RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1977 6. Baily JE and Ollis OF., Biochemical Engineering fundamentals, 2nd edition, McGraw-Hill Book Co., New York, 1986. 7. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo Press, Tokyo 1973. 8. Young M.M., Comprehensive Biotechnology: The Principles, applications and regulations of Biotechnology in Industry, Agriculture and Medicine, Vol 1, 2, 3 and 4. Reed Elsevier India Private Ltd, India, 2004. 9. Mansi EMTEL, Bryle CFA, Fermentation Microbiology and Biotechnology, 2nd Edition, Taylor & Francis Ltd. UK. 10. Books published by Madhya Pradesh Hindi Granth Acadmey, Bhopal.	
Suggestive digital platforms/web links- Nil	
Suggested equivalent online courses: Coursera, NPTEL, Career's 360	

Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial visit)		Table work/ Experiments	
	Total Marks : 100		
Any remarks/ suggestions:			

B. Sc. Third Year**Major Course I** Discipline Specific Elective 2 (Theory) (Group A Paper II)**Course Code:** S3-BTEC2D**Course Title:** Agriculture biotechnology

Credit- 04

Part A - Introduction		
Program : Degree		 Class: Year: III Session :2023-24 B.Sc. Year
Subject : Biotechnology		
1.	Course Code	S3-BTEC2D
2.	Course Title	Agriculture biotechnology
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective /Vocational/)	Discipline Specific Elective 2 (Theory) (Group A Paper II)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. The student will empower with the fundamental of the agriculture biotechnology such as organic farming Agrobiology and techniques. 2. The learner will get the deep understanding of soil microbiology, microbial diversity of soil and importance of organic farming. 3. Student will empower through the hand on training on composting, vermiculture and methane production. 4. Learned molecular techniques will provide knowledge of further application. 5. Basic principle biofertilizer and biopesticide development will impart field knowledge.
6.	Credit Value	4
7.	Total Marks	Max. Marks-30+70 Min. Passing Marks: 35

Part B - Content of the Course		
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P		
Unit	Topics	Number of Lectures (1 Hour Each)
I.	Organic farming: Biofertilizers and Biopesticides Biological N ₂ fixation, H ₂ production, biofertilizers and biopesticides; solid wastes; sources and management (composting, vermiculture and methane production). Single cell protein (Spirulina, yeast, mushroom).	12
II.	National and international status of organic farming .Agencies and institutions related to organic agriculture. Organic and Indian National Standards for organic products. Organic Food Quality and Human Health.	12
III.	Agrobiology Agrobacterium plant interaction; Virulence; Ti and Ri plasmids; Opines and their significance; TONA transfer; Disarming the Ti plasmid. Genetic Transformation Agrobacterium mediated gene delivery; Co integrate and binary vectors and their utility; Direct gene transfer PEG mediated, electroporation, particle bombardment and alternative methods; Screen able and selectable markers; Characterization of transgenics; Chloroplast transformation; Marker free methodologies; Gene targeting, Genetically modified crops.	12
IV.	Gene Editing- Gene transfer technique-physical chemical, Biological method; Gen isolation and gene silencing, mutagenesis-random & site directed, RNA structure of Ribozymes, Regulation of gene editing, Gene editing tools- CRISPR-Cas & TALEN, R Applications in crop improvement, seed industry and nutritional security.	12
V.	Techniques and Applications: enzyme detection, hybridization, PCR, Gene probe technology etc.; Strategies for controlling pathogen transfer; Biopesticides in integrated pest management	12

Part C - Learning Resources		
Text Books, Reference Books, Other Resources		
Suggested Readings: List of Recommended Books 1. Rao Subba, Soil microbiology. 2. Waksman and Starkey, Soil and microbes. 3. Mehrotra, Plant pathology. 4. Alexander, M. Introduction to Soil Microbiology, 3rd Edition. Wiley Eastern Ltd., New Delhi Purohit S.S., Microbiology. 5. Metcalf and Eddy Wastewater Engineering- Treatment, disposal and Reuse, Inc., Tata McGraw Hill, New Delhi. 6. M. Moo-young (Ed-in-chief) Comprehensive Biotechnology. Vol. 4,, Pergamon Press, Oxford.De, A.K., Environmental Chemistry, Wiley Eastern Ltd. New Delhi. 7. Allsopp D. and K.J. Seal Introduction to Biodeterioration, ELBS/Edward Arnold 8. Kristensen, P., Taji, A. and Reganold, J. (2006). Organic Agriculture: A Global Perspective. CSIRO Press, Victoria, Australia 9. Altieri, M. (1990). Agroecology: The Science of Sustainable Agriculture. Westview Press, Boulder, CO 10. Bavec, F. and Bavec, M. (2007). Organic Production and Use of Alternative Crops. CRC Press, Boca Raton, FL 11. Joshi, M., Setty, T.K.P. and Prabhakarasetty (2006). Sustainability through Organic farming. Ist Edition. Kalyani Publishers, Ludhiana, India. 12. Atwal, A. S. 1991. Agricultural Pests of India and South - East Asia. Kalyani Publishers, New Delhi. 13. Books published by Madhya Pradesh Hindi Granth Academy, Bhopal.		
Suggestive digital platforms/web links- www.biologyonline.com		
Suggested equivalent online courses: Coursera, NPTEL		

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE): 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE)	Class Test Assignment/Presentation	30
External Assessment: University Exam Section Time: 03.00 Hours	Section(A) : Very Short Questions Section (B) : Short Questions Section (C) : Long Questions	70
Any remarks/Suggestions:		

B. Sc. Third Year**Major Course II Discipline Specific Elective 2 (Practical) Group A Paper II****Course Code: S3-BTEC2Q****Course Title: Agriculture Biotechnology****Credit- 04**

Part A - Introduction		
Program : Degree		 Class: B.Sc. Year: III Year Session :2023-24
Subject : Biotechnology		
1.	Course Code	S3-BTEC2Q
2.	Course Title	Agriculture Biotechnology
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective /Vocational/)	Discipline Specific Elective 2 (Practical) Group A Paper II
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. The student will empower with the fundamental of the agriculture biotechnology such as organic farming agrobiology and techniques. 2. The learner will get the deep understanding of soil microbiology, microbial diversity of soil and importance of organic farming. 3. Student will empower through the hand on training on composting, vermiculture and methane production. 4. Learned molecular techniques will provide knowledge of further application. 5. Basic principle biofertilizer and biopesticide development will impart field knowledge.
6.	Credit Value	2
7.	Total Marks	Max. Marks-100 Min. Passing Marks: 35

Part B - Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (2 Hours Each)
	1. To study pollution stress by chlorophyll and carotenoid ratio from algae sample. 2. To study of effect of heavy metal on growth of bacteria. 3. Isolation and Enumeration of the microorganism from soil by serial dilution agar plate method. 4. Isolation of fungi from soil by warcup's method. 5. Isolation of azotobacter species from soil. 6. Isolation of microorganism from rhizosphere. 7. Isolation of microorganism from phyllosphere (phyloplane) by serial dilution, agar plate method or leaf impression method. 8. Plant diseases - leaf curl of papaya, rust of wheat, citrus canker, red rot of sugarcane. Study of weeds- Parthenium, water hyacinth 9. Visit to Apiculture area 10. Visit to Mushroom industry 11. Visit to terrace farming area 12. Study of policies and incentives of organic production 13. Study of farm inspection and certification. 14. Determination of amount of bleaching powder required to disinfect a water sample by Horrock's test. 15. To determine pH, electrical conductivity, total solids, total suspended solids and total dissolved solids in given sample of water. 16. To determine the amount of oil and grease content present in the given water sample	30
Keywords/Ta2s:		

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: 1. Rao, Subba, Soil microbiology. 2. Waksman and Starkey, Soil and microbes. 3. Mehrotra, Plant pathology . 4. Alexander, M. Introduction to Soil Microbiology, 3rd Edition. Wiley Eastern Ltd., New Delhi 5. Purohit, S.S., Microbiology. 6. Metcalf and Eddy, Wastewater Engineering- Treatment, disposal and Reuse., Inc., Tata McGraw Hill, New Delhi. 7. De., A.K., Environmental Chemistry, Wiley Eastern Ltd. New Delhi. 8. Joshi, M., Setty, T.K.P. and Prabhakarasetty (2006). Sustainability through Organic farming. 1st Edition. Kalyani Publishers, Ludhiana, India. 9. Books published by Madhya Pradesh Hindi Granth Academy, Bhopal.	
Suggestive digital platforms/web links- Nil	
Suggested equivalent online courses: Coursera, NPTEL	

Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar/ Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial visit)		Table work/ Experiments	
	Total Marks : 100		
Any remarks/ suggestions:			

B. Sc. Third Year

Major Course I Discipline Specific Elective 3 (Theory) (Group B Paper I)**Course Code: S3-BTEC3D****Course Title: Environmental Biotechnology****Credit- 04**

Part A - Introduction		
<u>Program: Degree</u> <u>Class: B.Sc.</u> <u>Year: III Year</u> <u>Session :2023-24</u> Subject:Biotechnology		
1.	Course Code	S3-BTEC3D
2.	Course Title	Environmental Biotechnology
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective/vocational/)	Discipline Specific Elective 3 (Theory) (Group B Paper I)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1.Deep understanding of existing and emerging technologies that are important in the area of environment and the principles and techniques which underline the environmental issues including air and water pollution. 2.Empowers the students with the knowledge of Domestic waste water treatment, Classification of wastewater treatment (physical, chemical and biological) 3.Students learn about concepts of Biodegradation, Biodegradation of hydrocarbon, and Measurement of biodegradation. Bioremediation- Concept, Methods of Bioremediation (In-situ and Ex-situ Bioremediation), and Xenobiotic biodegradation. 4.Learners will understand the concept of biodiversity: conservation and management, rules and acts.
6.	Credit Value	4
7.	Total Marks	Max. Marks-30+70 Min. Passing Marks: 35

Part B - Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (1 Hour Each)
I.	Environmental Pollution: Definition, principles and scope of ecology types of pollution, Oil pollution, Methods for the measurement of pollution; Methodology of environmental management - the problem solving approach, its limitations.	12
II.	Solid and Water wastes: sources and management (composting, vermiculture and methane production). Treatment of waste water, primary, secondary & Assessment of water quality.	12
III.	Global Environmental Problems: Ozone depletion, UV-B, green -house effect and acid rain. Biogas H ₂ Production	12
IV.	Degradation of Xenobiotics in Environment. Ecological considerations, decay behaviour & degradative plasmids; Hydrocarbons, substituted hydrocarbons, surfactants, pesticides, microbial leaching. Bioremediation of contaminated soils and waste land.	12
V.	Techniques and Applications: Methods of monitoring Pollution; Biological methods; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Strategies for controlling pathogen transfer; Chemical methods- Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Biosensors for pollution	12

Part C - Learning Resources		
Text Books, Reference Books, Other Resources		
Suggested Readings: 1. Sodhi G. S., Environmental Chemistry, Narosa Publishing House. 2. Das Satya N., Essential of Biotech for student, PeePee Publication & Distributor Ltd. 3. Verma Dhananjay, Environmental Awareness, M. P. Hindi Granth Academy. 4. Purohit S.S., Shammi Q.T. and Agrawal A. K ,A Test book of Environmental Sciences,, Student edition Jodhpur. 5. Agrawala, Environmental Studies Narosa Publishing House. 6. Mohapatra Pradipta Kumar, Text Book of Environmental Biotechnology , Willy Publication 7. Mohapatra Pradipta Kumar, Text Book of Environmental Biotechnology , I K International Publication 8. Kumar Pramod, Textbook of Environmental Biotechnology Woodhead Publishing India 9. Nachiketa Neeraj, Environment & Ecology a Dynamic Approach, G K Publication. 10. Sharma Vinay, Text Book of Environmental Biotechnology, Aavishkar Publication 11. Thakur Indu Shekhar, Environmental Biotechnology, Dream Tech Publication. 12. Books Published by Madhya Pradesh Hindi Granth Academy, Bhopal.		
Suggestive digital platforms/web links- www.biologyonline.com		
Suggested equivalent online courses: Course, NPTEL		

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE)	Class Test Assignment/Presentation	30
External Assessment : University Exam Section Time : 03.00 Hours	Section(A) : Very Short Questions Section (B) : Short Questions Section (C) : Long Questions	70
Any remarks/suggestions:		

B. Sc. Third Year

Major Course I Discipline Specific Elective 3 (Practical) (Group B Paper I)

Course Code: S3- BTEC 3 Q

Course Title: Environmental Biotechnology

Credit- 04

Part A - Introduction		
Program : Degree Class: B.Sc. Year: III Year Session :2023-24		
Subject: Biotechnology		
1.	Course Code	S3- BTEC 3 Q
2.	Course Title	Environmental Biotechnology
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective Vocational/)	Discipline Specific Elective 3 (Practical) (Group B Paper I)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. Deep understanding of existing and emerging technologies that are important in the area of environment and the principles and techniques which underline the environmental issues including air and water pollution. 2. Empowers the students with the knowledge of Domestic waste water treatment, Classification of wastewater treatment (physical, chemical and biological) 3. Students learn about concepts of Biodegradation, Biodegradation of hydrocarbon, Measurement of biodegradation. Bioremediation-Concept, Methods of Bioremediation (In-situ and Ex-situ Bioremediation), and Xenobiotic biodegradation. 4. Learners will understand the concept of biodiversity: conservation and management, rules and acts.
6.	Credit Value	2
7.	Total Marks	Max. Marks-100 Min. Passing Marks: 35

Part B - Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (2 Hour Each)
	Practicals: 1. Isolation of Cyanobacteria (blue green algae). 2. Estimation of nitrate. 3. Estimation of nitrite. 4. Estimation of ammonia. 5. Determination of biological oxygen demand (BOD) of water sample. 6. Determination of chemical oxygen demand (COD) of water sample. 7. To study air born microbes by agar plate technique. 8. To study pollution stress by chlorophyll and carotenoid ratio from algae sample. 9. To study of effect of heavy metal on growth of bacteria.	30
	Keywords/Tags: Nil	

Part C - Learning Resources		
Text Books, Reference Books, Other Resources		
Suggested Readings: 1. Sodhi G. S., Environmental Chemistry, Narosa Publishing House. 2. Das Satya N., Essential of Biotech for student, PeePee Publication & Distributor Ltd. 3. Verma Dhananjay, Environmental Awareness, M. P. Hindi Granth Academy. 4. Purohit S.S., Shammi Q.T. and Agrawal A. K ,A Test book of Environmental Sciences,, Student edition Jodhpur. 5. Agrawala, Environmental Studies Narosa Publishing House. 6. Mohapatra Pradipta Kumar, Text Book of Environmental Biotechnology ,Willy Publication 7. Mohapatra Pradipta Kumar, Text Book of Environmental Biotechnology, I K International Publication 8. Kumar Pramod, Textbook of Environmental Biotechnology Woodhead Publishing India 9. Nachiketa Neeraj, Environment & Ecology a Dynamic Approach, G K Publication. 10. Sharma Vinay, Text Book of Environmental Biotechnology, Aavishkar Publication 11. Thakur Indu Shekhar, Environmental Biotechnology, Dream Tech Publication. 13. Books Published by Madhya Pradesh Hindi Granth Academy, Bhopal.		
Suggestive digital platforms/web links- Nil		
Suggested equivalent online courses: Courses , NPTEL		

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE)	Class Test Assignment/Presentation	30
External Assessment : University Exam Section Time : 03.00 Hours	Section(A) : Very Short Questions Section (B) : Short Questions Section (C) : Long Questions	70
Any remarks/suggestion:	r \\	

B. Sc. Third Year**Major Course II** Discipline Specific Elective 4(Theory) (Group B Paper II)**Course Code:** S3- BTE C4Q**Course Title:** Bioinformatics**Credit- 04**

Part A - Introduction		
Program: Degree Class: B.Sc. Year : III Session : 2023-2024		
Subject: Biotechnology		
1.	Course Code	S3- BTE C4D
2.	Course Title	Bioinformatics
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective Vocational/)	Discipline Specific Elective 4 (Theory) (Group B Paper II)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology

5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. Will know the use of Bioinformatic tools and their applications. 2. Develop an understanding of basic theory of these computational tools. 3. Gain working knowledge of these computational tools and methods. 4. Appreciate their relevance for investigating specific contemporary biological questions. 5. Critically analyse and interpret results of their study.	
6.	Credit Value	4	
7.	Total Marks	Max. Marks-100	Min. Passini! Marks: 35

Part B - Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (1 Hour Each)
I.	Introduction to computers and Bioinformatics: History of Bioinformatics, Computer Organization: components, Memory devices; Comparison of different operating systems DOS, Windows, Linux. Comparison of different operating systems DOS, Windows, Linux. Computers in biology and medicine; Internet Technologies: Web Services - WWW; URL; Servers: Client/ Server essentials - Domain Name Server; FTP server; E-mail server; WEB servers; Web publishing-Browsers-IP Addressing. Sequence file formats: GenBank, FASTA, PIR, ALN/ClustalW2, GCG/MSF, and PDB.	12
II.	Proteomics and genomics: Aims, strategies and challenges in proteomics; proteomics technologies: Brief overview of prokaryotic and eukaryotic genome organization; extra-chromosomal DNA: bacterial plasmids, mitochondria and chloroplast. Genetic and physical maps; markers for genetic mapping; methods and techniques used for gene mapping, physical mapping, linkage analysis, cytogenetic techniques, FISH technique in gene mapping, somatic cell hybridization, radiation hybrid maps, in situ hybridization, comparative gene mapping.	12
III.	Overview of biological databases, nucleic acid & protein databases, primary, secondary, functional, composite, structural classification database, Sequence formats & storage, Access databases, Extract and create sub databases, limitations of existing databases. databases and search tools: biological background for sequence analysis; Identification of protein sequence from DNA sequence; searching of databases similar sequence; NCBI; publicly available tools; resources at EBI; resources on web; database mining tools	12
IV.	Database: Database concept; Database management system; Data generating techniques, Database browsing and Data retrieval; Data structures and Databases. Sequence and Genome Databases: Databases such as GenBank; EMBL; DDBJ; Swissprot etc	12
V.	Applications and techniques: clinical and biomedical applications of proteomics; Identification and classification of organisms using molecular markers- 16S rRNA typing/sequencing, SNPs; use of genomes to understand evolution of eukaryotes, track emerging diseases and design new drugs; determining gene location in genome sequence	12

Part C - Learning Resources		
Text Books, Reference Books, Other Resources		
Suggested Readings: 1. Sinha P K & Sinha Priti, Computer Fundamentals, Fourth Edition. 2. Greg Perry, SAMS teach your self open office.org. 3 Alexis & Mathews Leon, Fundamentals of information technology 4. Sharma Vinay, Munjal Ashok, Shankar Asheesh, A text book of Bioinformatics, 5. Rastogi publications.by Rastogi SC, Mandirreta Namita, Rastogi Parag, Bioinformatics Concepts, Skill and applications, Rastogi Publications 6. Books published by Madhya Pradesh Hindi Granth Academy, Bhopal		
Suggestive digital platforms/web links https://www.ncbi.nlm.nih.gov/ https://www.rcsb.org/ http://www.mbio.ncsu.edu/BioEdit/bioedit.html https://www.expasy.org/ https://swissmodel.expasy.org/ http://molprobitv.biochem.duke.edu/ https://web.expasy.org/protparam/ https://blast.ncbi.nlm.nih.gov/Blast.cgi?PAGE=Proteins		
Suggested equivalent online courses:		

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE)	Class Test Assignment/Presentation	30

External Assessment : University Exam Section Time : 03.00 Hours	Section(A) : Very Short Questions Section (B) : Short Questions Section (C) : Long Questions	70
Any remarks/suggestion:	r \	

B. Sc. Third Year**Major Course II** Discipline Specific Elective 4(Practical) (Group B Paper II)

Course Code: S3- BTE C4Q

Course Title: Bioinformatics

Credit- 02

Program: Degree Class: B.Sc. Year : III Session : 2023-2024		
Subject: Biotechnology		
1.	Course Code	S3- BTE C4Q
2.	Course Title	Bioinformatics
3.	Course Type (Core Course/Discipl ine Specific Elective/ Elective/ Generic Elective Nocational/)	Discipline Specific Elective 4 (Practical) (Group B Paper II)
4.	Pre-requisites	To study this course, Student must have Diploma in Biotechnology
5.	Course Learning outcomes	On successful completion of this course, the students will be able to: 1. Will know the use of Bioinformatic tools and their applications. 2. Develop an understanding of basic theory of these computational tools. 3. Gain working knowledge of these computational tools and methods. 4. Appreciate their relevance for investigating specific contemporary biological questions. 5. Critically analyse and interpret results of their study.
6.	Credit Value	2

SYLLABUS FOR THE DEGREE OF BACHELOR OF SCIENCE (BIOTECHNOLOGY) 2023 ONWARDS

7 .	Total Marks	Max . Marks-1 00 Min. Passini! Marks: 35
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Part B - Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (2 Hours Each)
I.	Practicals: 1. Searching PubMed , Introduction to NCBI, NCBI data bases, 2. Multiple sequence alignment, Primer designing, Phylogenetic Analysis. 3. Sequence information resource: . Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR) 4. Understanding and using: PDB, Swissprot, TREMBL 5. Using various BLAST and interpretation of results.	30

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: 1. Sinha P K & Sinha Priti, Computer Fundamentals, Fourth Edition. 2. Greg Perry, SAMS teach yourself open office.org. 3. Alexis & Mathews Leon, Fundamentals of information technology 4. Sharma Vinay, Munjal Ashok, Shankar Asheesh, A text book of Bioinformatics, 5. Rastogi publications by Rastogi SC, Mandirreta Namita, Rastogi Parag, Bioinformatics Concepts, Skill and applications, Rastogi Publications 6. Books published by Madhya Pradesh Hindi Granth Academy, Bhopal	
Suggestive digital platforms/web links- Suggestive digital platforms/web links https://www.ncbi.nlm.nih.gov/ https://www.rcsb.org/ http://www.mbio.ncsu.edu/BioEdit/bioedit.html	
Suggested equivalent online courses: Courses , NPTEL	

Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey/ Industrial visit)		Table work/ Experiments	
	Total Marks : 100		

B. Sc. Third Year**Minor\Elective (theory)****Course Code: S3-BTE C2 T****Course Title: Applied Biotechnology****Credit- 04**

Part A - Introduction			
Program : Degree		Class:	Year: III Year
Session :2023-24			
Subject: Biotechnology			
1	Course Code	S3-BTEC2T	
2	Course Title	Applied Biotechnology	
3	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective /Vocational/.)	Minor\Elective (theory)	
4.	Pre-requisites	This course can be opted as an elective by the students/Open for all	
5.	Course Learning	On completion of this course, students should be able to: 1. Students can depict about design, types of fermentor. Recent development in fermentation process & various optimization strategies of fermentation . 2. Learners can get inside of biofertilizer and biopesticide, global environmental problem, agrobiology, technique regulation and application. 3. . Students depict about concept of environment, principal technique and pollution as well as bioremediation, biodiversity, conservation and management. 4. I PR and patent and trade and entrepreneurship	
6.	Credit	4	
7.	Total Marks	Max. Marks-30+70	

Part B — Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (1 Hour Each)
I	Environmental Pollution - Basic concepts, significance, public awareness, public assessment water quality, treatment of waste water. biopesticide-bacterial and fungal, microbial leaching, biodegradation modern fuels.	12
II	National & International strategies of organic farming, organic food, quality & human health. Strategies for controlling pathogen transfer, integrated pest management , biofertilizers genetically modified crops.	1 2
III	Fermentation technology, basic principle of bioprocess technology, primary & secondary screening, strain improvement, inoculum development, industrial sterilization process, scale up & product recovery. Types of fermentation, factor affecting, fermentation design.	1 2
IV	Bioinformatics & Biostatistics History of bioinformatics, computer organization, Computer in biology, computer in biological data & their types, introduction to measurement of dispersion & central tendency, their types & application, data types & presentation modes.	1 2
V	IPR forms & scope, types, international organization like, WTO, TRIPS, & GATT. Biotechnology & IPR- plant variety protection, act. Animal breeder's, rights, patenting microbes organism and genes potential markers & variants.	1 2
Keywords Tags		

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: 1.Khan Irfan A. Fundamental of Biostatics. 2.Wanganeo & Singh, Application of statics in Biological Science by Parihar, (2012) Book Enclave publication. 3.Rao, P.S. Sunder An introduction to Biostatics. 4.De. A. K., Environmental Chemistry, W ilaey Easton Ltd. New Delhi. 5.S. Purohit S. S., Microbiology. 6.Dubey R. C., Advanced Biotechnology. 7.Kumar Anil & Garg Sarika, Enzymes and enzyme technology, Anshan publishing. 8.Jackson AT, Bioprocess in Biotechnology (1991), Prentice Halls Engalwood Cliff. 9.Stranburge RF, Whitakar A, Principles of fermentation technology (1997) Pergammers press exfer. 10.Kristerson P., Taji, A. and Reganold I ,Organic Agriculture- A global perspective 2006) CSIRA Press, Australia. 11. Altieri M, Agroecology: The Science of sustainable agriculture (1990) West view press 12.Joshi, M., Setty, T.K.V., and Prabhakara Setty, Sustainability through organic farming (2006) , Kalyani Publishers, Ludhiana, India. 13.Sinha P. K. & Sinha Pi iti, Computer fundamentals. 14.Sharma Vinay, Ashok Munjal, Asheesh Shan kar, A text book of Bioinformatics Rastogi Publication. 15.Nambisan Padma, An introduction to ethical , Safety & intellectual property rights issue in Biotechnology . 16.Goe1, & Parashar, IPR, Biosefty & Bioethics. 17.Gupta CB & Khanka SS., Entrepreneurship and small business management ,S chand & sons. 18.Tiway P. & Pandey, P. ,Practical Guide for basic bioinformatics and biostatics . 19.Agrawal S. K. Environmental Bioteclinology. 20.Books published by Madhya Pradesh Hindi Granth Academy, Bhopal.	
Suggestive digital platforms/web links- mvw.biologyonline.com	
Suggested equivalent online courses: Coursera, NPTEL	

Part D-Assessment and Evaluation	
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous <u>Comprehensive Evaluation</u> (CCE) : 30 marks University Exam (UE) 70 marks	
Internal Assessment : Continuous Comprehensive Evaluation (CCE)	Class Test Assignment/Presentation 30
External Assessment : University Exam Section Time : 03.00 Hours	Section(A) : Very Short Questions Section (B) : Short Questions 70 Section (C) : Long Questions
Any remarks/suggestions:	

B. Sc. Third Year

Minor/Elective (Practical)
Course Code: S3-BTE C2 p

Course Title: Minor/Elective (Practical)
Credit- 04

Part A - Introduction

Subject: Biotechnology		
1.	Course Code	S3-BTEC2P
2.	Course Title	Applied Biotechnology
3.	Course Type (Core Course/Discipline Specific Elective/ Elective/ Generic Elective /Vocational/.)	Minor/Elective (Practical)
4.	Pre-requisites	This course can be opted as an elective by the students/Open for all
5.	Course Learning outcomes	On completion of this course, students should be able to: 1.Students can depict about design, types of fermentor. Recent development in fermentation process & various optimization strategic of fermentation. 2.Learners can get inside of biofertilizer and biopesticide, global environmental problem agrobiolgy techniques regulation and application. 3.Students depict about concept of environment principal technique and pollution as well as bioremediation, biodiversity, conservation and management. 4.They may creat interest in the bioinformatics tools and their application computational tools and method. Rational for and against IPR and patent and trade and entrepreneurship.
6.	Credit Value	2
7.	Total Marks	Max. Marks-100

**Minor elective
practicals**

Part B — Content of the Course		
Total No. of Lectures- Tutorials-Practical (in hours per week): L-T-P:		
Unit	Topics	Number of Lectures (2 Hours Each)
	1.Prepare a marksheet of class subjects. 2.Prepare a bar chart, pie chart for analysis of election results. 3.Problem based on probability and standard deviation. 4.Retrieval of biological data resources & data. 5.Use M.S. Word to insert a table in to document. 6.Demonstration of fermentor. 7.Demonstration of PCR. 8.Production of ethanol by yeast. 9.Isolation of Agotobacter, Rhizobium and Cyanobacteria from soil 10.Isolation of microorganism from polluted site/ industrial waste. 11.Degradation of 2,4-D by bacteria. 12.Immobilization of microbial cells by Ca alginate. 13.Isolation of microorganism from rhizosphere. 14.Study of policies and incentives of organic production. 15.Study of air borne microorganism by agar plate techniques. 16.Understanding the use of NCBI phylogenetic analysis. 17.Proxy filing of Indian product patent	

Part C - Learning Resources

Part C - Learning Resources	
Text Books, Reference Books, Other Resources	
Suggested Readings: 1.Parihar, Wanganeo & Singh, Application of statics in Biological Science by Parihar, (2012) Book Enclave publication. 2.De. A. K., Environmental Chemistry, W ilaey Easton Ltd. New Del hi. 3.Dubey R. C., Advanced Biotechnology. 4.Kumar Anil & Garg Sarika, Enzymes and enzyme technology, Anshan publishing. 5.Stranburge RF, W hitakar A, Principles of fermentation technology (1997) Pergammers press exfer. 6.Joshi, M., Setty, T.K.V., and Prabhakara Setty, Sustainability through organic farming (2006) , Kalyani Publishers, Ludhiana, India. 7.Sinha P. K. & Sinha Priti, Computer fundamentals. 8.Sharma Vinay, Ashok Munjal, Asheesh Shankar. A text book of Bioinformatics Rastogi Publication. 9.Nambisan Padma, An introduction to ethical , Safety & intellectual property rights issue in Biotechnology . 10.Gupta CB & Khanka SS., Entrepreneurship and small business management ,S chand & sons. 11.Tiway P. & Pandey, P., Practical Guide for basic bioinformatics and biostatistics. 12.Books published by Madhya Pradesh Hindi Granth Academy, Bhopal.	
Suggestive digital platforms/web links- www.biologyonline.com	
Suggested equivalent online courses: Coursera, NPTEL	

Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Max. marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)		Table work / Experiments	
	Total Marks : 100		
Any remarks/ suggestions:			