Tumkur University

Listing of Courses from V to VI Semesters for Undergraduate Program in BIOTECHNOLOGY

Sem. No.	Course Category	Course Code	Course Title	Credits Assigned	Instructional hours per week		Duration of Exam (Hrs.)	Exam/ Evaluation Pattern (Marks)		
					Theory	Practical		IA	Exam	Total
V	DSC	BTDSC-5	Genetic Engineering (Theory)	4	4		2	40	60	100
		BTDSC-5P	Genetic Engineering (Practicals)	2		4	3	25	25	50
		BTDSC-6	Plant and Animal Biotechnology (Theory)	4	4		2	40	60	100
		BTDSC-6P	Plant and Animal Biotechnology (Practicals)	2		4	3	25	25	50
	SEC	BTSEC-4	Biotechnology Skills and Analytical Techniques	3	2	1	2	50	50	100
VI	DSC	BTDSC-7	Immunology and Medical Biotechnology (Theory)	4	4		2	40	60	100
		BTDSC-7P	Immunology and Medical Biotechnology (Practicals)	2		4	3	25	25	50
		BTDSC-8	Bioprocess Technology and Environmental Biotechnology (Theory)	4	4		2	40	60	100
		BTDSC-8P	Bioprocess Technology and Environmental Biotechnology (Practicals)	2		4	3	25	25	50
	SEC	BTSEC-5	Bioinformatic Skills	2	2		2	25	25	50
	Internship	BTDSC-9	Internship	2	3-4 weeks (Report & Viva)			25	25	50

Note: If any Elective or Skill enhancement course involves theory-cum-practical, then IA to SEE marks will be in the ratio of 50:50. The practical part is to be evaluated as part of IA. Semester end examination is only in theory component and questions from practical part, if any.

12/9/2023

CHAIR MAN
BOS IN Biotechnology
TUMKUR UNIVERSITY
TUMKUR-572103.

B.Sc. Biotechnology

Program Name	B.Sc. Biotechnology		Semester	5th Semester
Course Title	Genetic Engineering (Theory)			
Course Code:	BTDSC-5	No. of Theory Credits		04
Contact hours	60hrs	Duration of ESA/Exam		03 Hours
Formative Assessment Marks	40	Summative Assessment Marks		60

Course Objectives

1. Understand the fundamental principles and techniques of genetic engineering.
2. Explore the applications of genetic engineering in agriculture, medicine, biotechnology, and environmental science.
3. Develop practical skills in genetic engineering techniques and laboratory procedures.
4. Gain knowledge of gene expression regulation and genetic modification methods.
5. Analyze and interpret genetic data using bioinformatics tools.
6. Enhance critical thinking and problem-solving skills through discussions and case studies.
7. Stay updated on emerging trends and advancements in genetic engineering.

Course Outcomes:

1. Demonstrate a thorough understanding of the fundamental principles and techniques of genetic engineering.
2. Apply the knowledge of genetic engineering to diverse applications in agriculture, medicine, biotechnology, and environmental science.
3. Perform laboratory procedures and develop practical skills in genetic engineering techniques. CO4: Explain gene expression regulation mechanisms and apply genetic modification methods effectively.
4. Analyse and interpret genetic data using bioinformatics tools for a comprehensive understanding of gene function and evolutionary relationships.
5. Evaluate genetic engineering's ethical, social, and legal implications and propose responsible solutions.
6. Stay updated with recent advancements in genetic engineering, critically evaluate emerging trends, and assess their potential impact on various fields.

Content of Theory	60 hrs
Unit I- Tools of Genetic Engineering	**15 hrs.**
Definition, scope, and historical overview of genetic engineering. Importance and applications in various fields. **Isolation techniques of DNA and RNA**- Techniques for DNA isolation and purification methods (Plants, animals, microorganisms and plasmids) and RNA. Methods for quantification and characterization. **Recombinant DNA technology** – Introduction to molecular cloning. Prokaryotic and eukaryotic host cell. Overview of cloning vectors. Plasmids, phage, cosmid, BAC, and YAC. Features and applications of cloning vectors in genetic engineering. Enzymes used in recombinant DNA technology: Restriction endonucleases, Polymerases, Ligase, kinases, and phosphatases. Expression vectors.	
Unit II- Techniques in Genetic Engineering	**15 Hrs.**
Gene introduction Techniques - Methods of gene delivery. Physical, chemical, and biological methods. Transformation, transfection, electroporation and micro-injection. **Gene Manipulation Techniques** - Gene knockout techniques in bacterial and eukaryotic organisms. **Screenings of recombinants**: Replica plating, Blue-White selection, colony hybridization, FISH. Protein Expression and Purification. Techniques for expressing recombinant proteins using bacterial, animal, and plant expression systems.	
Unit III- Genome Editing and Applications of Genetic Engineering	**15 Hrs.**
Gene library: Types and applications. **Genome Editing** - Introduction to genome editing techniques- Principles and applications of genome editing techniques- CRISPR-Cas9 and Site-directed mutagenesis. Overview of the diverse applications of genetic engineering. DNA fingerprinting and its applications in forensics. Production of biopharmaceuticals using recombinant DNA technology. The role of biotechnology in sustainable crops and livestock improvement. Industrial applications of genetic engineering, such as enzyme production, biofuel production, and bioremediation.	
Unit IV- Bioinformatics, Biosafety and Bioethics	**15 Hrs.**
Bioinformatics and Computational Tools: Introduction to bioinformatics. Genome sequencing techniques, Genome projects: A brief account on Human Genome Project, biological databases. Tools for biological sequence analysis – Sequence comparison and phylogenetic analysis. Role of Bioinformatics in genetic engineering. **Biosafety assessment of transgenic plants**: Biosafety guidelines, Potential risks and benefits of transgenic plants, International regulatory frameworks for releasing and commercializing genetically modified organisms (GMOs). **Bioethics**: Public perception and consumer acceptance of transgenic plants. Ethical considerations of GMOs. Socio-economic impacts of GMO **IPR and Patents:** A brief account.	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Summative Assessment = 60 Marks	
Formative Assessment Occasion/ type	**Weightage in Marks**
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	**60 marks + 40 marks = 100 marks**

Course Title	**Genetic Engineering**	Practical Credits	**02**
Course No./ **Course Code:**	BTDSC- 5P	Contact hours	**60 hrs**

Practical

1. **Introduction to Laboratory Techniques** - Safety guidelines and laboratory protocols
   Aseptic techniques and proper handling of materials. Basic equipment and instrument operation
   Preparation of reagents and media
2. **Nucleic Acid Extraction and Quantification-** DNA extraction from different sources (e.g., bacteria, plant, animal). RNA extraction and purification methods. Quality assessment and quantification of nucleic acids (spectrophotometry, gel electrophoresis).
3. **Polymerase Chain Reaction (PCR)**
   Primer design and optimization
   PCR setup and cycling conditions
   Agarose gel electrophoresis for PCR product analysis
4. **Gel Electrophoresis and DNA Analysis**
   Agarose gel electrophoresis for DNA fragment separation and analysis
   DNA size determination using molecular weight markers
   DNA band visualization techniques (e.g., ethidium bromide staining, DNA intercalating dyes)
5. **Bioinformatics for Genetic Engineering**
   Introduction to bioinformatics databases and tools, Sequence analysis (e.g., BLAST, multiple sequence alignment). Prediction of protein secondary structure and function

Practical Assessment

Assessment

Formative Assessment		**Summative Assessment**	**Total Marks**
Assessment Occasion/ type	**Weightage in Marks**	**Practical Exams**	
Record	05	25	50
Test	10		
Attendance	05		
Performance	05		
Total	**25**	**25**	

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3. Genome 4 (2017) 4th ed., Brown, TA, Garland Science, ISBN: 978-0815345084.
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5. Genomics and Personalized Medicine: What Everyone Needs to Know (2016) 1st ed., Snyder, M, OUP-USA, ISBN: 978-0190234768.
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16. Bioinformatics and Functional Genomics (2015) 3rd ed., Pevsner, J, Wiley-Blackwell, ISBN: 978-1118581780.
17. Genomic Approaches for Cross-Species Extrapolation in Toxicology (2019) 1st ed., Wichard, J, and Maertens, A, CRC Press, ISBN: 978-0815348023.
18. Introduction to Genetic Analysis (2020) 12th ed., Griffiths, AJF, Wessler, SR, Carroll, SB, and Doebley, J, W.H. Freeman, ISBN: 978-1319149609.
19. Genetic Engineering: Principles and Methods (2019) 3rd ed., Fowler, MR, CABI, ISBN: 978-1789240605.

B.Sc. Biotechnology

Program Name	B.Sc. Biotechnology		Semester	5th Semester
Course Title	Plant and Animal Biotechnology (Theory)			
Course Code:	BTDSC-6		No. of Theory Credits	04
Contact hours	60hrs		Duration of ESA/Exam	3 Hours
Formative Assessment Marks		40	Summative Assessment Marks	60

Course Objectives

1. To understand the fundamental aspects of plant tissue culture.
2. Learn about biotechnological tools and techniques used in plant research and agriculture.
3. Explore methods of introducing foreign genes into plants through transformation techniques.
4. Gain practical skills in plant tissue culture for plant improvement and propagation.
5. To understand the concepts of modern technology pertaining to large-scale production of agricultural products and evaluate several methods for stable and transient plant transformation.
6. Design strategies for plant genetic manipulation against biotic and abiotic stressors.
7. Hypothesize strategies to increase plant yield and fruit/seed quality.

Course Outcomes:

After completing this course, the student is expected to learn the following:

1. Demonstrate a comprehensive understanding of plant biology, physiology, genetics, and molecular biology.
2. Apply biotechnological tools and techniques used in plant research and agriculture, such as plant tissue culture, genetic engineering and transgenics.
3. Execute plant tissue culture techniques for callus induction, somatic embryogenesis, and micropropagation, and apply them in plant breeding and propagation.
4. Perform plant transformation methods and demonstrate the ability to introduce foreign genes into plants using different techniques.
5. Utilize molecular markers and genomic approaches for genetic mapping, marker-assisted selection, and plant breeding programs.
6. Apply molecular biology techniques, including PCR, DNA sequencing, and gene expression analysis, to investigate and analyze plant genetic information.
7. Utilize bioinformatics tools and databases to analyze and interpret plant genomic and transcriptomic data.
8. Apply knowledge about ethical considerations and regulatory frameworks associated with plant biotechnology and genetically modified crops.
9. Apply acquired knowledge and problem-solving skills to address real-world challenges in agriculture, food security, and environmental sustainability using plant biotechnology approaches.

Content of Theory	60 hrs
Unit–I – Plant Tissue culture	**15 hrs.**
Introduction, history, definition, and concept of totipotency. Principles of plant tissue culture-cytodifferentiation and morphogenesis, Media and laboratory organization. Techniques – Organ culture (meristem and embryo), callus culture, Somatic embryogenesis and synthetic seeds. **Haploid culture** – Anther, Pollen and Ovule culture, A brief account on protoplast culture and somatic hybridization. Somaclonal variation. **Secondary metabolites-** *In vitro* secondary metabolite production, Suspension cultures, cell cultures, growth vs secondary metabolite production, bioreactors and scaling up of secondary metabolite production, limitations, and applications. Production of (Shikonin and Ginseng).	
Unit -II Unit -II Transgenic Plants and Biofertilizers.	**15 hrs.**
Overview of transgenic plants and their significance in agriculture. - Techniques for introducing foreign genes into plants: Agrobacterium-mediated transformation, biolistic, microinjection, electroporation and chemical mediated transformation. Role of reporter genes in screening and selection. Plant Molecular markers. **Applications of Transgenic Plants** - Improved crop traits through genetic engineering: pest resistance, herbicide tolerance, disease resistance, and abiotic stress tolerance. **Biofertilizers-** Rhizobium, Micorrhiza, Azolla	
Unit–III Animal Cell culture methods	**15 Hrs.**
History and laboratory organization, Media. Cell types and culture characterstics. Pluripotency, Multipotency, Differentiation, Trans differentiation and Reprogramming. **Biology and characterization of cultured cells-** cell adhesion, proliferation, differentiation, morphology of cells, and identification. The basic technique of mammalian cell culture in vitro, Measuring parameters of growth in cultured cells, cell viability, and cytotoxicity. Large-scale culture of cell lines- monolayer, suspension, and immobilized cultures. **Organ and histotypic culture-** Technique, advantages, limitations, applications. Stem cells: types (embryonic, adult, induced pluripotent), isolation, identification, expansion, differentiation and uses, stem cell engineering, ethical issues.	
Unit IV –Transgenic animals and cloning.	**15 hrs.**
Gene constructs, promoter/ enhancer sequences for transgene expression in animals. Selectable markers for animal cells- thymidine kinase and CAT. **Transfection of animal cells-** calcium phosphate coprecipitation, electroporation, lipofection, peptides, direct DNA transfer, viral vectors, Retrovirus, microinjection. Transgene identification methods. **Transgenic and genome-edited animals-** Ethical issues in transgenesis. Manipulation of animal reproduction and characterization of animal genes, Embryo transfer in cattle and applications. Somatic cell cloning - cloning of Dolly. Ethical issues.	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz, and Assignments. Case studies highlight successful applications and challenges in transgenic crop development. Group discussion and critical analysis of scientific papers related to transgenic plants.

Summative Assessment = 60 Marks	
Formative Assessment Occasion/ type	**Weightage in Marks**
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	**60 marks + 40 marks = 100 marks**

Course Title	**Plant and Animal Biotechnology**	Practical Credits	2
Course No./ Course Code:	**BTDSC -6P**	Contact hours	**60 hrs**

Content of Practical

1. Laboratory organization of basic and commercial plant tissue culture
2. Media preparation (MS, B5), solid media preparation, and Liquid media preparation
3. Explant preparation – Leaf, bud, rhizome, and meristem
4. Synthetic seed production
5. Callus culture- Initiation and establishment of different types of callus cultures
6. Micropropagation with a suitable example – Stage 0. 1, 2, 3, and 4
7. Staining, cell viability, and cell count of cell cultures
8. Preparation of cell culture media: Preparation of basic cell culture media, such as Dulbecco's Modified Eagle Medium (DMEM), antibiotics, and other required additives.
9. Extraction of serum.
10. Aseptic techniques and sterile handling: Practicing aseptic techniques, including properly handling tools and equipment, working in a laminar flow hood, and maintaining sterility throughout the cell culture process.
11. Filter sterilization: Practice filter sterilization for sensitive media ingredients.
12. Cell counting and viability assessment: Count cells using a hemocytometer or automated cell counter, and perform viability assays (e.g., trypan blue exclusion) to determine the percentage of viable cells.
13. Cell staining and microscopy: Staining the cultured cells using dyes such as hematoxylin and eosin (H&E), and observe them under a light microscope to study cell morphology and structure.
14. Contamination identification and troubleshooting: Learn to identify and troubleshoot common issues in cell culture, such as contamination by bacteria, fungi, or mycoplasma, and implement appropriate corrective measures.
15. Experimental design and data analysis: Students can design and execute simple experiments, record and analyze data, and interpret the results based on their observations and measurements.

Practical Assessment			
Assessment			
Formative Assessment		Summative Assessment	Total Marks
Assessment Occasion/ type	Weightage in Marks	Practical Exams	
Record	05	25	50
Test	10		
Attendance	05		
Performance	05		
Total	25	25	

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B.Sc. Biotechnology

Program Name	B.Sc. Biotechnology		Semester	6th Semester
Course Title	Immunology and Medical Biotechnology (Theory)			
Course Code:	BTDSC -7		No. of Theory Credits	04
Contact hours	60hrs		Duration of ESA/Exam	03 Hours
Formative Assessment Marks		40	Summative Assessment Marks	60

Course Objectives

1. To understand the basic aspects of medical biotechnology, pathogenesis of human diseases, disease diagnosis, management, drug discovery, development and Clinical research.
2. To provide an overview of genetic diseases and the diagnostic techniques used in the medical field.
3. This course focuses on the relationship between microbes and human health. Students will study important diseases emphasizing on etiology, pathogenesis, diagnosis, treatment, and prevention.

Course Outcomes:

After completing this course, the student is expected to learn the following:

1. Understanding the basics of genetic information responsible for disease development
2. Understanding the classical and advanced methods used for the diagnosis of various diseases
3. Students will have a clear understanding of microbial diseases, host pathogen interactions, and the issues associated with drug-resistant microorganisms.
4. Students also comprehend the significance of normal flora associated with human health.
5. They will also learn about drug- Receptor interactions, drug toxicology and its pharmacological significance, conducting clinical trials, ethical issues in clinical research and a preliminary idea about artificial intelligence and personalized medicine as highly emerging areas in medical science.

Content of Theory	60 hrs.
Unit I: Cells and Organs of the Immune System	**15hrs**
Introduction to the Immune System: History of Immunology, Types of Immunity: first and second line of defense, innate and acquired/adaptive immunity, specificity, diversity. Cells of the immune system: Antigen-presenting cells (APCs), Role of B and T-lymphocytes in Humoral immunity and cell-mediated immunity, primary and secondary immune response, Immunization, memory. Organs of the Immune system: Thymus, bone marrow, spleen, Lymph Node, peripheral lymphoid organs	
Unit -II Molecules of the Immune System	**15 hrs.**
Antigens and haptens: Properties (foreignness, molecular size, heterogeneity). Adjuvants. Antigenicity and Immunogenicity. Affinity and Avidity. B and T cell epitopes, superantigens Immunoglobulins: Classification, structure, and function. Antibody diversity. Monoclonal and polyclonal antibodies. Major histocompatibility complexes: Classification, structure, and function. Cytokines: Classification and function, Hypersensitivity: Reactions – Types I, II, and III. Delayed Type Hypersensitive Response.	
Unit -III Immunotechniques and vaccines	**15 hrs.**
Structure and properties of antigens- iso- and allo-antigens, antigen specificity, Cross-reactivity, Precipitation. Immunodiffusion reactions: Radial immunodiffusion, Ouchterlony double diffusion, Immunoelectrophoresis. Agglutination: Agglutination reactions. ELISA, RIA. Immunocytochemistry. Fluorescent Techniques. Vaccines: Conventional vaccines (Live attenuated, heat killed and toxoid), Recombinant vaccines-subunit (Peptide. Protein and DNA) Attenuated recombinant vaccine, vector recombinant vaccine. CoVID19 vaccines. edible vaccines, plantibodies, and Cancer vaccines.	
Unit IV: Microbial disease of human and therapy	**15 hrs.**
Microbial diseases in humans: Mode of infection, symptoms, epidemiology and control measures of diseases caused by Viruses (Hepatitis-B), Bacteria (Typhoid), Fungi (Aspergillosis), Protozoa (Malaria) Autoimmune disorders with examples. Immunodeficiencies: Primary and secondary, immunodeficiencies; acquired immunodeficiency syndrome. cancer immunotherapy. Role of biotechnology in diagnosis and therapy. Gene therapy.	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Summative Assessment = 60 Marks	
Formative Assessment Occasion/ type	Weightage in Marks
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	60 marks + 40 marks = 100 marks

Course Title	Immunology and Medical Biotechnology	Practical Credits	02
Course No.	BTDSC-7P BTC 107	Contact hours	60 hrs

Content of Practical

1. Hemagglutination of ABO Blood groups
2. Determination of Rh factor
3. Whole Count of WBC using Hemocytometer
4. Cells of the Immune System (differential
5. Radial immunodiffusion
6. Ouchterlony double diffusion
7. ELISA – Demonstrate
8. Serum Immunoelectrophoresis
9. Western Blotting
10. Determination of blood clotting time
11. Haemoglobin estimation using a haemometer
12. Estimation of serum cholesterol
13. Demonstration using Diagnostic kits
14. SGOT
15. SGPT and
16. Blood Urea
17. Widal test
18. VDRL test

Practical Assessment			
Assessment			
Formative Assessment		**Summative Assessment**	**Total Marks**
Assessment Occasion/type	**Weightage in Marks**	**Practical Exams**	
Record	05	25	50
Test	10		
Attendance	05		
Performance	05		
Total	**25**	**25**	

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B.Sc. Biotechnology Sixth Semester

Program Name	B.Sc. Biotechnology		Semester	6th Semester
Course Title	Bioprocess Technology and Environmental Biotechnology (Theory)			
Course Code:	BTDSC-8	108	No. of Theory Credits	04
Contact hours	60hrs		Duration of ESA/Exam	3 Hours
Formative Assessment Marks	40		Summative Assessment Marks	60

Course Objectives:

1. The objective of this paper is to introduce students to the fundamentals of bioprocess engineering and technology, and its industrial applications, thus enabling the students to understand the requirements of bioprocess technology in advanced and emerging areas of biological science.
2. The field of biotechnology is developing very rapidly and needs skilled engineers with a bioprocess engineering background to design, build, control, and operate bioreactors and fermenters.
3. Design bioreactors for the production of various products.
4. Analyze and formulate mechanisms for enzymatic reactions.
5. Understand soluble and immobilized enzyme technologies for the production of industrial and medical products.
6. Predict important yield coefficients using the principles of stoichiometry and energetics of microbial growth.
7. Perform simulations of microbial growth and metabolism.
8. Present knowledge about major metabolic pathways and those related to biofuel production from microbes.
9. Analyze metabolic network and metabolic flux.
10. Estimate kinetic parameters from raw fermentation data.
11. Specify required technologies to effectively utilize genetically engineered microorganisms for bioprocessing.

Course outcome:

At the end of the course, the student should be able to:

1. Students can understand the exploitation of microorganisms for industrial use and their improvement, stoichiometric analysis, and formulation of media for efficient growth and production of microbial or cell-based products.
2. Students will also have an idea about the design, operation, and specific applications of various bioreactors.
3. Graduates acquire professional leadership roles in bioprocess engineering and related fields leading to successful career.
4. Graduates establish commitment and contribute toward sustainable and bio-based economic development for a better society.
5. Graduates engage in lifelong learning by conducting practical engineering tasks.
6. Able to acquire a sound knowledge in mathematics and natural science and apply engineering principles in determining and solving contemporary and complex problems related to bioprocessing. Able to formulate and operate conversion processes of biological resources into bio-based value-added materials related to food, feed, fuels,

pharmaceutical, nutraceutical, biomaterials, or biochemicals.

7. Able to design biological reactions and reactors including their materials, instrumentation, control, and modeling.
8. Able to communicate a creative idea and works effectively within the professional community and larger society.
9. Able to demonstrate an ability to work in multidisciplinary and multicultural teams in developing innovative engineering solutions using complex problem-solving skills.
10. Able to conduct practice-based tasks related to bioprocessing in a responsible, safe, voluntary, self-motivated, and ethical manner.
11. Able to appraise bioprocessing and bioproducts manufacturing and valorization using entrepreneurship principles

Content of Theory	60 hrs.
UNIT- I – Introduction to bioprocess technology	**10hrs**
Basic components of fermentation technology. Strain improvement of industrially important microorganisms. Types of microbial culture and its growth kinetics– Batch, Fed-batch, and Continuous culture. Principles of upstream processing – Media preparation, Inocula development, and sterilization	
UNIT- II-Bioreactors and downstream processing	
Bioreactors- Design and components - Impeller, Baffles, Sparger; **Specialized bioreactors-** design and their functions: airlift bioreactor, tubular bioreactors, membrane bioreactors, tower bioreactors, fluidized bed reactor, packed bed reactors **Downstream processing-** cell disruption, precipitation methods, solid-liquid separation, liquid-liquid extraction, filtration, centrifugation, chromatography, drying devices (Lyophilization and spray dry technology), crystallization, biosensors-construction and applications. Microbial production of ethanol, amylase, Penicillin, Vinegar and Single Cell Proteins.	**20hrs**
Unit III- Fundamentals of Environmental Biotechnology	**15hrs**
Introduction to Environmental Biotechnology- Principles of Environmental Science. Role of Biotechnology in Environmental Conservation. Microbial Processes in Environmental Biotechnology. Pollution and Biotechnology – Major issues in environmental pollution and the role of biotechnology in addressing them. Use of biosensors in pollution monitoring. Biotechnological Methods in Pollution Abatement-Reduction of CO2 emission. Addressing eutrophication through biotechnological interventions. Application of cell immobilization techniques in pollution abatement.	
Unit IV- Bioremediation and Waste Management	**15hrs**
Importance of bioremediation in environmental cleanup. Types of contaminants suitable for bioremediation. Microorganisms used in bioremediation. *In-situ* Bioremediation Methods. – Bioaugmentation. Biostimulation. Bioventing. Phytoremediation. *Ex-situ* Bioremediation Methods – Composting, Land farming, Biopile and bioslurry systems. Bio metallurgy and bio-mining. Waste water Management. Waste water Characterization and Composition. Biological Processes in Waste water Treatment. Activated Sludge Process and Biological Nutrient Removal. Anaerobic Digestion and Biogas Production. Solid Waste Management. Xenobiotics – Characterstics, types and their bidegradation.	

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz and Assignments

Summative Assessment = 60 Marks	
Formative Assessment Occasion/ type	**Weightage in Marks**
Attendance	10
Seminar	10
Debates and Quiz	10
Test	10
Total	**60 marks + 40 marks = 100 marks**

ourse Title	Bioprocess Technology	Practical Credits	02
Course No.	BTDSC- 8P	Contact hours	60 hrs

Content of Practical

1. Bacterial growth curve.
2. Calculation of the thermal death point (TDP) of a microbial sample.
3. Study of fermentor- Demonstration.
4. Production of wine–estimation of the percentage of alcohol, total acidity & volatile acidity in wine.
5. Production and analysis of ethanol.
6. Production and analysis of amylase.
7. Production and analysis of lactic acid.
8. Isolation of industrially important microorganisms from natural resources.
9. Estimation of Biological Oxygen Demand
10. Estimation of Chemical Oxygen Demand
11. Visit to Vermicompost/Biofertilizer/Biogas facility.

Practical Assessment			
Assessment			
Formative Assessment		Summative Assessment	Total Marks
Assessment Occasion/ type	**Weightage in Marks**	**Practical Exams**	
Record	05	25	50
Test	10		
Attendance	05		
Performance	05		
Total	**25**	**25**	

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Program Name	**B.Sc. Biotechnology**	Semester	**5th Semester**
Course Title		**Biotechnology Skills and Analytical Techniques**	
Course No.	**BTSEC-4**	No. of Theory +Practical Credits	**2+1 (Theory+Practicals)**
Contact hours	**45 hrs**	Duration of ESA/Exam	**02 hrs**
Formative Assessment (T+P)	**50**	Summative Assessment Marks (T+P)	**50**

Unit-I Insights into the biotechnology industry and basic professional skills **30 Hrs**

Biotechnology Industry in Indian and Global Context- Organization in the context of large/medium/small enterprises, their structure, and benefits.

Industry-oriented professional skills: Planning and organizing skills, decision-making, problem-solving skills, analytical thinking, critical thinking, team management, and risk assessment. Interpersonal skills: Writing skills, reading skills, oral communication, conflict resolution techniques, interpretation of research data, and troubleshooting in the workplace.

Digital skills: Basic computer skills (MS Office, excel, power point, internet) for the workplace. Professional E-mail drafting skills and PowerPoint presentation skills. Overview of good manufacturing practices (GMP), Good Documentation practices (GDP), and good laboratory practices (GLP).

Unit- II Basic laboratory skills and Analytical Techniques **15 Hrs**

Analytical skills in the laboratory: Preparations of solutions, molarity, molality, normality, mass percent % (w/w), percent by volume (%v/v), parts per million (ppm), parts per billion (ppb), dilution of concentrated solutions. Standard solutions, stock solution, and solution of acids. Reagent bottle label reading and precautions.

Analytical techniques: Basic principle, operation, application, maintenance, calibration, validation, and troubleshooting of instruments- Microscope-Simple, compound, TEM, SEM, fluorescence. Centrifuge and different types, Hot air oven, pH meter, different types of pH electrodes Autoclave, pH meter, Incubator, BOD, COD, cell counter, Laminar airflow. Spectroscopy-Colorimeter, UV-Visible spectroscopy. Electrophoresis- Agarose Gel electrophoresis, SDS-PAGE, PCR, Conductivity meter, and Potentiometer. Biosafety cabinets.

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz, and Assignments

Program Name	**B.Sc. Biotechnology**	Semester	**5th Semester**
Course Title		**Bioinformatic Skills**	
Course No.	**BTSEC-5**	No. of Theory +Practical Credits	**2 (Theory+Practicals)**
Contact hours	**30 hrs**	Duration of ESA/Exam	**02 hrs**
Formative Assessment (T+P)	**25**	Summative Assessment Marks (T+P)	**25**

Unit-I Essentials of Bioinformatics **15 Hrs**

Introduction, Overview of bioinformatics and its applications in biology and medicine Introduction to biological databases and data formats.

Bioinformatics Database search engines – Text-based search engines (Entrez, DBGET / LinkDB).

Sequence file formats: Various file formats for bio-molecular sequences:

GenBank, FASTA, GCG, MSF etc.

Sequence Analysis: Sequence databases and retrieval methods, Basics of sequence analysis and sequence alignment algorithms, pairwise sequence alignment techniques (e.g., Needleman-Wunsch, Smith-Waterman), Multiple sequence alignment algorithms (e.g., ClustalW, MUSCLE), Sequence similarity searching (e.g., BLAST, FASTA). Basics of Object-Oriented Programming like (C++ / JAVA), JavaScript, R and Python / Perl, and operating system like Linux.

Genome Database- Plant genome database- Plant GDB, Microbial Genomes database: -MBGD, Viral genome database:-ICTVdb

Practical applications: Case studies and projects illustrating the application of bioinformatics in genomics, personalized medicine, or other relevant areas

Unit- II Structural Bioinformatics, Molecular Modelling and Drug Designing **15 Hrs**

Introduction to Structural Bioinformatics, Protein Structure Prediction: Introduction to protein structure and its importance, Prediction of protein secondary structure and tertiary structure. Protein structure visualization tools. Motif and Domain: Motif databases and analysis tools. Domain databases (CDD, SMART, ProDom) and Analysis tools Introduction to protein-ligand interactions and drug discovery. Analysing Molecular Surfaces, cavities, and intermolecular interaction.

Gene Expression Analysis: Introduction to gene expression data analysis, Pre-processing and normalization of gene expression data.

Ethical considerations in bioinformatics research. Communication and collaboration in a bioinformatics team

Pedagogy: Lectures, Seminars, Industry Visits, Debates, Quiz, and Assignments

12/9/2023

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