(Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06MABTE01	Title of the Course	Environmental Biotechnology
Total Credits Of the Course	4	Hours per Week	4

Course Objectives:	1. To bring an enthusiasm on environmental protection and it should give the contribution of biotechnology techniques to keep the environment clean and healthy. 2. To highlight on the economic aspects in the application of biotechnology in protecting the environment from pollution. 3. To acquaint students to various waste water treatment processes to improve quality of waste water. 4. To teach students measurement of water pollution. 5. To familiarize students to Biosensors

Course Content

Unit	Description	Weightage * (%)
1.	Pollution- Definition & types, Xenobiotic compounds in the environment, Biomagnification, Global environmental problems- The Green house effect, Ozone depletion &Acid Rain, Nuclear waste and its impact, Air pollution and control measure of particulate pollutants in industries (Gravitational Settling Chamber, Wet Scrubbers & Electrostatic precipitator)	25%
2.	Microbiology of waste water treatment, Measurement of pollutant (BOD, COD, TOC, Acidity, Alkalinity & bacterial measurement) of wastewater, Treatment of waste water:- aerobic process - activated sludge, oxidation ponds, trickling filter, rotating biological contactor. Anaerobic process-anaerobic digestion, UASBR. Treatment schemes for waste waters of dairy and tannery industries	25%
3.	Biodegradation – Definition, Mechanism, Biodegradation of Aromatic hydrocarbon & n-alkanes. Bioremediation (Microbial& Phytoremediation-Introduction & its types) Bioleaching-General properties of microorganisms involved in it. Types, Mechanism (Direct & Indirect), factors affecting the process of bioleaching ,Copper bioleaching	25%
4.	Biosensor: Principle, types (Potentiometric, Amperometric & Conductometric biosensor), applications and limitations. Bioplastic Introduction, technology and applications, Biofertilizer (Microorganisms used as biofertilizers), Biomethanation-Production & factors affecting biogas yield, Biofuel- Production & advantages,	25%

Teaching-Learning Methodology	Classroom lectures and use of chalk & blackboard. ICT tools involving smartboards ,powerpoint presentations, videos, animations &models.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Recognize the global environmental concerns
2.	Understandtheprocessofwastewatertreatmentandcontrolmeasuresofair pollution
3..	Understand the principle and application of Biosensor
4.	Understand the role of microorganism in reducing pollution and extraction of metals.
5.	Understand the importance of biofertilizer, biomethanation, biofuel

Suggested References:	
Sr. No.	References
1.	Environmental pollution control engineering-C. S. Rao
2.	Industrial microbiology–Whitaker
3	Industrial microbiology- A. H. Patel
4.	Biotechnology-Expanding horizons-B.D Singh

5.	A text book of biotechnology– R C Dubey
6.	Environmental Biotechnology, Indu Shekhar Thakur, IK International
7.	Biotechnology– U Satyanarayan
8.	Environment microbiology –Gerba & Pepler,
9.	Wastewater Microbiology Bitton, - 2 ed, Wiley
10.	Textbook of Environmental Biotechnology, Pradipta Kumar Mohapatra, IK Int.

On-line resources to be used if available as reference material
On-line Resources

((Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06MABTE02	Title of the Course	Fermentation Technology
Total Credits Of the Course	4	Hours per Week	4

Course Objectives:	1. To understand the Basic concept of Fermentation technology. 2. To have an overview of Upstream and downstream process. 3. To understand Fermentation Products used for human welfare.

Course Content		
Unit	Description	Weightage* (%)
1.	Introduction to fermentation, chronological development of fermentation industries, ranges of fermentation Process, Introduction to Batch, Fed-batch and continuous fermentation process. Ideal characteristic of Production strain, Screening (Primary and secondary), Concepts of strain improvement (mutation, Recombination, R-DNA technology), Preservation of strain (storage of reduced temperature, storage in dehydrated form). Inoculums development(yeast/spore)	25
2.	Production Media (synthetic and crude), Raw material used as Production Media (Carbon and Nitrogen sources). Sterilization of Production Media, fermenter and feed. Introduction to media optimization. Over view Solid substrate and submerged fermentation. Definition of fermenter and bioreactor, Characteristic and design of ideal fermenter (fabrication, agitation aeration). Types of fermenter (Tower fermenter, Air lift fermenter). Measuring variable (Temperature, DO and pH) Introduction to Scale up and scale down	25
3.	Downstream processing: introduction to downstream processing, Recovery Process- Filtration, precipitation, Centrifugation, cell disruption, solvent recovery ultra filtration, drying and crystallization. Brief introduction to Disposal of effluents. Microbial Assay (growth factors and growth inhibitor). Concept of fermentation Economics.	25
4.	Production- Antibiotic (Penicillin), Solvent (ethanol), SCP-microorganism in SCP and Mushroom cultivation, Dairy product (Cheese), Beverage (wine (red/white)). Spoilage and preservation of food. Biotransformation (vinegar), Introduction to Probiotics (temph and yogurt)	25

Teaching-Learning Methodology	Chalkboard, PowerPoint presentation, quizzes, Video available on NPTEL and BISAG

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weight age
1.	Internal Written/Practical Examination(AsperCBCSR.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course ,the learner will be able to	
1.	Will study basics of fermentation of Biotechnology and screening and preservation of strain.
2.	To understand media and fermenter design and types, sterilization and concepts of scale up and scale down.
3.	To understand various downstream processing.
4.	To study various fermentation product and spoilage and preservation of food technique.

Suggested References:	
Sr. No.	References
1.	Principles of Fermentation technology, Whittaker, Stanburry & Hall.
2.	Industrial Microbiology, LEJR Casida
3	Industrial Microbiology ,A.H.Patel
4.	Comprehensive biotechnology-Murry Moo Young
5.	Fermentation Microbiology and Biotechnology- EI Mansi and Byre
6.	Methods of Industrial microbiology- Sikyt.

On-line resources to be used if available as reference material
On-line Resources
Nptel.ac.in
SANDHAN, BISAG

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(Bachelor of Science)

(B.Sc) (Biotechnology) Semester VI

Course Code	US06MABTE03	Title of the Course	Biotechnology Practical
Total Credits Of the Course	4	Hours/ Week	8

Course Objectives:	1. The student will study various analysis and estimation technique for water & air pollutants. 2. Students will have practical approach on various production biofuel and degradation of biohazard waste. 3. The student will study screening technique and estimation of products.

Course Content

	Section-I	Weightage* (%)
	1. Quatantitative and qualitative analysis of water 2. Quantitative and qualitative analysis of air 3. Estimation of phosphate from the sample. 4. Estimation of sulphate from the sample. 5. Isolation and characterization of bacteria from crude petroleum oil contaminated soil. 6. Estimation of Dissolved oxygen of the water sample. 7. Estimation of chemical oxygen demand of the water sample. 8. Isolation of *rhizobium* bacteria from leguminous plants. 9. Demonstration of the production of biofuel from algae. 10. Demonstration of production of bioethanol from waste product. 11. To estimate the amount of glucose from the blood by using glucometer.	50
.	**Section –II**	
	1. Estimation of alcohol from the given sample 2. Estimation of penicillin from the given sample 3. Estimation of gluconic acid from the given sample 4. Estimation of streptomycin from the given sample. 5. Estimation of total sugar by Cole's method 6. Bioassay of antibiotics(cup borer method and multidisc) 7. Screening of amylase/gelatinase/protease producing microorganism 8. Screening of antibiotics – crowded plate and Wilkins method. 9. MBRT 10. Quantitative and Qualitative analysis of food. 11. Report/presentation on fermented food.	50

Teaching-Learning Methodology	Chalkboard, powerpoint presentation, quizzes,Video available on NPTEL and BISAG

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written/Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Student will have idea about various analysis and estimation technique used for measuring pollutants in water.
2.	Will understanding various screening techniques.
3.	Study fermented food and assay of fermented products.

Suggested References:	
Sr. No.	References
1.	Experimental Microbiology- Rakesh J patel
2.	Environmental biotechnology laboratory manual-Dr. Ismail Saadoun
3.	On-line resources

On-lineResources
Nptel.ac.in, SANDHAN, BISAG

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(Bachelor of Science)
(B.Sc) (Biotechnology) Semester VI

Course Code	US06MIBTE01	Title of the Course	Bioinformatics
Total Credits of the Course	02	Hours per Week	02

Course Objectives	1. To understand basic concepts, classification various databases used in biological systems. 2. To introduce the tools used inbioinformatics

Course Content		
Unit 1	Introduction of bioinformatics, and its application. Databases, types (Primary & secondary/ type of resources), Nucleic acid databases (GenBank, DDBJ, EMBL), Protein databases (UniProt, PDB & MMDB), Bibliographic databases (PubMed, PMC, OMIM), Structural Databases (CATH & SCOP)	Weight age*(%) 50%
Unit 2	Tools in Bioinformatics: Introduction into pairwise and multiple sequence alignment Basic concept & bioinformatics tools: Similarity search tools (BLAST), Primer Designing, multiple sequence alignment (ClustalW), phylogenetic analysis (Phylip)	50%

Teaching-Assignments, Learning	Lecture, Recitation, Group discussion, Guest speaker, Debate, Seminar, Quizzes.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	CEE: Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance, etc	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	The students will be able to understand the basic concepts various databases and tools.
2.	Students will be able to understand the concepts and parameters used to search within the sequences and structural databases.

Suggested References:	
Sr No	References 1. Boxevanis & Ouellette: Bioinformatics: A Practical guide to the analysis of Genes and Proteins. 2. Orengo, Jones & Thornton: Bioinformatics: Genes, Proteins and computers 3. David Mount : Bioinformatics : Sequence and genome analysis 4. Higgins & Taylor: Bioinformatics: Sequence, structure and databank.
On-line resources to be used if available as reference material	
On-line Resources	
Relevant entries on Wikipedia and Encyclopaedia Britannica	

B.Sc. Sem.-V

Course Code	US06MIBTE02	Title of the Course	Practicals
Total Credits of the Course	02	Hours per Week	04

Course Objectives	3. To introduce the tools used in bioinformatics and their result interpretation. 4. To use the tools of bioinformatics and their optimization

Course Content

1. Searching the literature databases for a specific Article (Searching & Downloading).
2. To search for a particular nucleotide sequence from the NCBI databases.
3. To Procure the structure of protein sequence using nucleotide sequence using PIR/ SwissProt
4. Refining the test based search using simple/ Advance query forms in Enters/ SRS-query systems
5. Using BLAST to search homology sequences in the databases.
6. Using Primer designing software to generate primers for target sequences.
7. To use phylogenetic software to interpret/ generate the phylogenetic tree.
8. To use multiple sequence alignment software and its interpretation.

Teaching-Assignments, Learning	Lecture, Recitation, Group discussion, Guest speaker, Debate, Seminar, Quizzes.

Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	CEE: Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance, etc	50%
2.	University Examination	50%

Course Outcomes:
Having completed this course, the learner will be able to

1.	The students will be able to understand the concepts behind various databases and tools.
2.	Students will be able to use the various free tools to understand and optimize to generate the results.

Suggested References:	
Sr No	References 5. Boxevanis& Ouellette: Bioinformatics: A Practical guide to the analysis of Genes and Proteins. 6. Orengo, Jones & Thornton: Bioinformatics: Genes, Proteins and computers 7. David Mount : Bioinformatics : Sequence and genome analysis 8. Higgins & Taylor: Bioinformatics: Sequence, structure and databank. 9. McCammon &Hervey: Molecular dynamics of Protein & Nucleic acids. 10. Molecular modelling: principles and applications by Leach A. R.
On-line resources to be used if available as reference material	
On-line Resources	
Relevant entries on Wikipedia and Encyclopaedia Britannica	