Programme	BS Biotechnology	Course Code	BT. 401	Credit Hours	2+1
Course Title	Microbial Biotechnology				

Course Introduction

The course is designed to acquaint students with how modern methods may be employed to enhance the characteristics of microbes that are commonly used in various industries including food, agriculture and pharmaceutical. This course explores the vast scope and issues of microbial biotechnology, focusing on the unique capabilities of microbes, including their tolerance to extreme conditions and their use in genetic modification.

Learning Outcomes

On the completion of the course, the students will:

- Assess the roles of microorganisms in various fields of biotechnology
- Apply techniques for the cultivation, manipulation, and utilization of microorganisms.
- Evaluate microbial metabolic pathways for biotechnological applications.

Course Content

Theory Unit

- Issues and scope of microbial biotechnology
- Microbes as tools for microbiological research,
- Microbes tolerating extreme conditions: Extremophiles, Thermophiles, Cryophiles and Acidophiles Alkaliphiles, Halophiles, Radioresistors, Tardigrades
- Genetically modified microorganisms
- Role of fermentation in microbial biotechnology: Fermentation media, industrial microorganisms, Types of fermentation, Recent advances in microbial fermentation, Types of bioreactors
- Upstream and downstream processing, History, Comparison of upstream and downstream processing,
- Significance of microorganisms in food production, Food microbiology
- Significance of microorganisms in pharmaceuticals
- Significance of microorganisms in industrial products
- Role of microbes in bioremediation
- Role of microbes in biosensors
- Vaccine development and production
- Biofertilizer, Composting
- Microbial enhanced oil recovery (MEOR)
- Biofuels
- Use of microbes in petroleum industry
- Microbial role in regulatory mechanism of plant
- Biopesticides
- Insights into microbial physiology based on whole genome sequencing
- Insights into microbial physiology based on metabolomics
- Insights into microbial physiology based on proteomics
- Microbial metabolism and metabolic engineering
- Probiotics and prebiotics: fundamental aspects and benefits

- Production of single cell proteins
- Probiotics and prebiotics: fundamental aspects and benefits
- Production of single cell proteins
- Industrially important microbial enzymes
- Significance of microbes in agriculture
- Assessment of epithelium adhesion potential of probiotics via cell adhesion assay
- Patentability of microorganisms

Practical Unit

- Determination of intensity of staleness and bacterial population of different milk samples
- Isolation and screening of nicotine metabolizing bacteria from tobacco field soil through serial dilution method
- Isolation and screening of plastic metabolizing bacteria from plastic contaminated soil through serial dilution method
- Isolation and screening of BTEX metabolizing bacteria from petroleum contaminated soil through serial dilution method
- Estimation of BTEX removal efficiency of bacteria through DCPIP
- Assessment of hemolytic capability of probiotics
- Estimation of cholesterol assimilation potential of gut bacteria via kit method
- Extraction of bacterial metabolites for identification via GC-MS analysis
- Extraction and preparation of bacterial protein sample for analysis via LC-MS
- Lab scale production of bacterial enzymes
- Lab scale production of alcohol by yeast
- Effect of nicotine degrading bacteria on germination of seedling
- Isolation and screening of probiotic bacteria from fish and chicken gut
- Assessment of antimicrobial potential of probiotics
- Assessment of bile salts an

Textbooks and Reading Material

- Naga, R.M. Sesan, A.A. Chizoba, I. Ezugwu, Lizziane, K. W. E. Laura, S. Fangang, M. (2024). *Microbial Biotechnology for Bioenergy. 1st Edition.* eBook ISBN: 9780443141133
- Eric, L. Gothandam, K. M. Nandita, D. Shivendu, R. (2020). Environmental Biotechnology. Volume 2. Springer International Publishing. ISBN: 9783030381967, 303038196X.
- Arora, N. K. and Bouizgarne, B. (2022). *Microbial BioTechnology for Sustainable Agriculture Volume 1* (Vol. 33). Springer Nature.
- Agathos, S.N.N. and Reineke, W. (2002). Biotechnology for the Environment: Soil Remediation. Springer-Verlag New York, LLC.
- Sibi, G. (2023). *Environmental Biotechnology, Fundamentals to Modern Techniques. 1st Edition.* CRC Press.
- Stevens, C. Verhe, R. Verhé, R. (2004). Renewable Bioresources: Scope and Modification for Non-Food Applications. Wiley, John and Sons, Incorporation

Research Articles (Practicals)

- Muccee, F., Ejaz, S., & Riaz, N. (2019). Toluene degradation via a unique metabolic route in indigenous bacterial species. *Archives of microbiology*, *201*, 1369-1383.
- Mohammadpour, H., Shahriarinour, M., & Yousefi, R. (2020). Benzene Degradation by Free and Immobilized Bacillus glycinifermantans Strain GO-13T Using GO Sheets. *Polish Journal of Environmental Studies*, *29*(4).
- Hussain, N., Muccee, F., Hammad, M., Mohiuddin, F., Bunny, S. M., & Shahab, A. (2024). Molecular and metabolic characterization of petroleum hydrocarbons degrading. *Polish Journal of Microbiology*, *73*(1), 107-120.
- Sharma, J., Gurung, T., Upadhyay, A., Nandy, K., Agnihotri, P., & Mitra, A. K. (2014). Isolation and characterization of plastic degrading bacteria from soil collected from the dumping grounds of an industrial area. *International journal of advanced and innovative research*, *3*(3), 225-232.
- Jardine, J. L., Stoychev, S., Mavumengwana, V., & Ubomba-Jaswa, E. (2018). Screening of potential bioremediation enzymes from hot spring bacteria using conventional plate assays and liquid chromatography-Tandem mass spectrometry (Lc-Ms/Ms). *Journal of environmental management*, *223*, 787-796.

Teaching Learning Strategies

- Class Lecture
- Class Discussions
- Class Tutorials
- Lab Demonstration

Assignments: Types and Number with Calendar

- 1st Quiz in 4th Week of 5 marks
- 2nd Quiz in 10th Week of 5 marks
- 3rd Quiz in 14th Week of 5 marks
- 1st Assignment in 8th Week of 10 marks

Assessment

Sr. No.	Elements	Weightage	Details
1	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2	Formative Assessment	25%	Continuous assessment includes: Classroom participation, assignments, presentations, viva voce, attitude and behavior, hands-on-activities, short tests, projects, practical, reflections, readings, quizzes etc.
3	Final Assessment	40%	Written Examination at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.