**UNIVERSITY OF GONDAR**

**INSTITUTE OF BIOTECHNOLOGY**

**DEPARTMENT OF INDUSTRIAL BIOTECHNOLOGY**

**COURSE SYLLABUS FOR MICROBIAL BIOTECHNOLOGY**

**Course Title:** **Microbial Biotechnology**

**Course Code: Biot. 631**

**ECTS: 7**

**Lecture: 3 hours/wk**

**Laboratory: 3 hours/wk**

**Collaborative learning: 2 hours/wk**

**Independent learning: 5 hours/wk**

**Length of time: 16 weeks**

**Co-requisite module: None**

**Pre-requisite module: None**

**Barred combination module: None**

**Module description**

This module has two parts: microbial technology and enzyme technology. Topics covered under microbial technology include isolation and preservation of industrially important microbial strains, genetics of microorganisms, strain improvement using classical and modern recombinant techniques, microbial growth kinetics, medium optimization and scale up, and growth of microorganisms under different environmental conditions. Design and operation of fermentors, downstream processing, microbial insecticides, microbial plant growth promotion, and use of microorganism for energy production are also topics to be discussed in detail. The part on enzyme technology offers fundamental understanding of enzyme function and will teach theoretical and experimental methods that form the basis for enzyme characterization. Topics covered include catalytic principles and reaction mechanisms of enzymes, binding energy and catalysis, enzyme kinetics (steady-state and pre steady-state), inhibition (reversible and irreversible) and its applications, practical methods in enzymology (for example studies of enzyme kinetics and reaction mechanisms, detection of intermediates, active-site titration), environmental effects on enzymes (for example pH, temperature, organic solvents), protein engineering (aims and strategies).

**Module content**

1. Biotechnological application of microorganisms - Microbial derived products and their application; Bioactive compounds; Organic acids and alcohols; Amino acids and other small compounds; Proteins and other microbial biopolymers; Microbial waste treatment
2. Commonly used cells - Microbial cells; Mammalian cells; Plant cells; Insect cells
3. Isolation, screening, and strain improvement of microorganisms- Microbial diversity; Isolation and screening of microorganisms; Strain improvement; Preservation of microbial cells
4. Cultivation of microorganisms - Solid state fermentation; Submerged fermentation; Anaerobic fermentation; Cultivation of extremophiles ; Mammalian, plant, and insect cell cultures; Medium development and fermentation optimization; Scale-up of fermentation processes
5. Design, operation, and monitoring of fermentation bioreactors- Batch culture fermentation; Continuous culture; Components of a fermentor and their design; Fermentor preparation and use; Common measurement and control systems; Monitoring of bioreactors
6. Microbiology of microbial fermentation and fermentation kinetics - Microbial growth; Mass balance for bioreactors; Fermentation kinetics
7. Downstream processing - Isolation and identification of small molecules; Purification and characterization of macromolecules; Scale –up of downstream processing; Quality assurance and quality control
8. Microbial Genetics - Bacterial genetics and genome informatics; Genetics of *Streptomyces* and other actinomycets; Molecular biology and genetics of *Bacillus;* Genetics of yeasts and other fungi; Genetically transformed cells and their application
9. Microbial products through the application of recombinant DNA technology- Proteins and other biopolymers; Antibiotics and other small molecules; Pathway engineering of microbial cells; Expression of microbial products in plants and animals; Environmental application of microorganisms; Microbial processes for the treatment of industrial and domestic waste; Microbial degradation of xenobiotics; Utilization of waste biomass for synthesis of biotechnologically useful products; Bofilms and bio-corrosion
10. Plant growth promoting microorganisms - Nitrogen fixation; Plant growth promotion by free-living bacteria; Microbial insecticides; Insecticidal toxins of *Bacillus thurengensis;* Baculoviruses as biocontrol agents; Biocontrol of plant pathogens and pests; Other biocontrol agents; Transgenic plants expressing microbial products
11. Role of microorganisms for the production of energy - Types of bioenergy; Liquid biofuels through fermentation; Enzymatic processes for the production of biodiese; Biodiesels from algae; Biogas production