

GENERIC ELECTIVES (GE-8: APPLICATIONS OF MICROBES IN BIOTECHNOLOGY)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course	Department offering the course
		Lecture	Tutorial	Practical/ Practice			
MICROB-GE8: APPLICATIONS OF MICROBES IN BIOTECHNOLOGY	4	2	0	2	None	NIL	Microbiology

Learning Objectives

The Learning Objectives of this course are as follows:

- The main objective of this course is to provide the students a clear understanding on the biotechnological potential of microorganisms in production of important industrial products like amino acids, antibiotics, vitamins, biopolysaccharides, bioplastics, pharmaceutical products, high fructose corn syrup, biofertilizers, biopesticides, transgenic plants, biofuels and biogas.
- They will also learn about the use of microorganisms for detoxification of industrial effluents, biogas production and extraction of metals from even low-grade ores.

Learning outcomes

The Learning Outcomes of this course are as follows:

- The student will be able to describe the concept of genetic manipulation of microbes by metabolic engineering and the production of important microbial products of immense industrial and medical/therapeutic value.
- The student will be able to describe the use of microbes in agricultural biotechnology for the formulation of biopesticides, biofertilizers, transgenic plants with desirable traits like disease resistance etc; and the importance of microorganisms in environmental management and biofuels production.
- The student will be able to demonstrate whole cell and enzyme immobilization techniques with strategies of dye decolorization using microorganisms.
- The student will be able to demonstrate the isolation and screening of enzyme producers from soil and symbiotic & asymbiotic nitrogen fixers.

- The student will be able to collect, analyse and interpret data on commercially available microbial products; and describe the cultivation and importance of edible mushrooms as well as single cell proteins.

SYLLABUS OF MICROB-GE8

UNIT – I (2 Weeks)

General Microbial Biotechnology: Scope of microbial biotechnology in agriculture, healthcare, environmental management, genomics, and proteomics, with suitable examples. Microbes commonly used in microbial biotechnology: viruses, bacteria, fungi. Relevance of natural, laboratory-selected mutant and genetically engineered microbes (GEMs), primary and secondary metabolites, metabolic engineering.

UNIT – II (6 Weeks)

Biotechnological potential of microbes in industry and medicine: Production and applications of microbial products: amino acids (glutamic acid), antibiotics (streptomycin), vitamins (vitamin B12), polysaccharide (xanthan gum), bioplastic (PHB), high fructose corn syrup using immobilized microbial enzyme glucose isomerase. Production and applications of important medicinal products: Insulin, recombinant vaccine (Covishield) and Microbial biosensor (glucose oxidase), gene therapy for SCID in humans using virus

UNIT – III (7 Weeks)

Agricultural and Environmental Biotechnology: Biofertilizers and biopesticides in agriculture: definition, classification with examples, advantages and disadvantages. Fertilizers from agricultural waste. Development of transgenic crops with important traits such as resistance to insects and viruses, herbicide resistance and environmental stress (drought and frost). Brief description of Bt cotton and Golden rice. Biofuel production from lignocellulosic waste and algal biomass, biogas (methane and hydrogen) production using microbes. Role of microbes in bioremediation (superbug, oilzapper, concentration of uranium from waste using bacteria). Biodegradation of xenobiotics (types of xenobiotics, hazards from xenobiotics, origin of microbial capacity to degrade xenobiotics and suitable examples) and microbial mining (mineral recovery of metals by bioleaching)

Practical component –

UNIT – 1 (4 Weeks)

Microbial enzyme immobilization and dye degradation: Performing yeast cell immobilization and enzyme immobilization in suitable polymers by calcium alginate method, studying the activity and reuse of the immobilized enzyme for recycling purpose, observing dye decolorization/degradation using bacteria or fungi.

UNIT – 2 (6 Weeks)

Enzymes and microbes from soil: Screening of soil samples for isolation of hydrolytic enzymes: protease, lipase, cellulase, xylanase (any two) producing microorganisms using plate assay, isolation of symbiotic nitrogen fixer: Rhizobium from root nodules, isolation of asymbiotic nitrogen fixers from soil: Azotobacter and Azospirillum

UNIT – 3 (5 Weeks)

Microbial products: Student group project: Conducting a market survey to identify any five popular microbial products and working to identify the microbe(s) involved in its production and the method of its preparation. Study of mushroom cultivation: importance, types of edible mushrooms and their cultivation, introduction to medicinal mushrooms. Single cell protein from algae Spirulina & Chlorella: medicinal importance, advantages, disadvantages and production strategies.

Essential/recommended readings

1. Prescott's Microbiology by J. M. Willey, K. Sandman and D. Wood. 11th edition. McGrawHill Higher Education, USA. 2019.
2. Biotechnology: A Textbook of Industrial Microbiology by W. Crueger, A. Crueger and K.R.Aneja. 3rd edition. Medtech Publisher, India. 2017.
3. Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker and S.J. Hall. 3rd edition. Elsevier Science Ltd, Netherlands. 2016.
4. A Textbook of Biotechnology by R.C. Dubey. 5th edition. S. Chand and Co, India. 2014.
5. Molecular Biotechnology by B.R. Glick, J.J. Pasternak and C.L. Patten. 4th edition, ASM Press, USA. 2009.
6. Microbial Biotechnology by A.N. Glazer and H. Nikaido. 2nd edition. Cambridge University Press, UK. 2007.
7. Elements of Biotechnology by P.K. Gupta. 2nd edition. Rastogi Publications, India. 2009.
8. Basic Biotechnology by C. Ratledge and B. Kristiansen. 3rd edition. Cambridge University Press, UK. 2006.
9. Modern Industrial Microbiology and Biotechnology by Naduka Okafor. Science Publishers, USA. 2007.
10. Manual of Industrial Microbiology and Biotechnology by A.L. Demain, J.E. Davies and R.M. Atlas. 2nd edition. ASM Press, USA. 1999.

Suggestive readings (if any)

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.