

Title: Environmental Biotechnology [3-0-0-6]**Content :**

1. Introduction: Introduction to environment; pollution (soil, air and water) and its control; pollution indicators; waste management: domestic, industrial, solid and hazardous wastes.
2. Bio & Phytoremediation:
 - a) Remediation: chemical, physical, biological & phytoremediation
 - b) Microbes in bioremediation: Biodiversity and its conservation; Geochemical cycles, Role of microorganisms in geochemical cycles; microbial energy metabolism, microbial ecology; strain improvement.
 - c) Applications of bacteria and fungi: methods and strategies of application (biostimulation, bioaugmentation) – examples, bioremediation of metals (Cr, As, Se, Hg), radionuclides (U, Te), organic pollutants (PAHs, PCBs, Pesticides, TNT etc.), technological aspects of bioremediation (in situ, ex situ); White rot fungi vs specialized degrading bacteria: examples, uses and advantages vs disadvantages.
 - d) Applications of plants: Fundamentals and description of major methods of application (phytoaccumulation, phytovolatilization, rhizofiltration, phytostabilization).
3. Environmental biotechnology & its various applications:
 - a) Bioinsecticides: *Bacillus thuringiensis*, Baculoviruses, uses, genetic modifications and aspects of safety in their use;
 - b) Biofungicides: Description of mode of actions and mechanisms (e.g. *Trichoderma*, *Pseudomonas fluorescens*);
 - c) Biofertilizers: Description of mode of actions and mechanisms (e.g. *Trichoderma*, *Pseudomonas fluorescens*); Symbiotic systems between plants – microorganisms (nitrogen fixing symbiosis, mycorrhiza fungi symbiosis), Plant growth promoting rhizobacteria (PGPR) – uses, practical aspects and problems in application.
 - d) Biofuels & biosurfactants: Metabolic engineering of microbes; biogas; bioethanol; biodiesel; biohydrogen; Description of the industrial processes involved, microorganisms and biotechnological interventions for optimization of production; Microbiologically enhanced oil recovery (MEOR); Production of biosurfactants: bioemulsifiers.
 - e) Bioplastics & Bioleaching of metals: Production of bioplastics. Bioleaching of metals.

Texts / References:

1. G. M. Evans and J. C. Furlong (2003), *Environmental Biotechnology: Theory and Applications*, Wiley Publishers.
2. B. Ritmann and P. L. McCarty, (2000), *Environmental Biotechnology: Principle & Applications*, 2nd Ed., McGraw Hill Science.
3. Scragg A., (2005) *Environmental Biotechnology*. Pearson Education Limited.
4. J. S. Devinny, M. A. Deshusses and T. S. Webster, (1998), *Biofiltration for Air Pollution Control*, CRC Press.
5. H. J. Rehm and G. Reed, (2001), *Biotechnology – A Multi-volume Comprehensive Treatise*, Vol. 11, 2nd Ed., VCH Publishers Inc.
6. H. S. Peavy, D. R. Rowe and G. Tchobanoglous, (2013), *Environmental Engineering*, McGraw-Hill Inc.
7. Research papers and Review articles chosen by the course instructor