BTOE 004: PHYTOREMEDIATION

Course Objective:

- To understanding of the processes involved in phytoremediation, i.e. the use of plants and their associated microbes to remediate environmental pollution.

Credits: 03 L-T-P-J: 3-0-0-0

Module No.	Course Content	Teaching Hours/ Percentage
I	Basic Physiological Processes: Basic Plant anatomy and physiology, Microbial processes, bio-catalysis, symbiosis with plant roots, plant processes, inorganic nutrition, water uptake and transpiration, photosynthetic production of phytochemicals, root exudation and root turnover, biometabolism.	**10//25%**
II	Pollutants in environment and ecotoxicology: sources of organic and inorganic pollutants in environment, plant ecotoxicology Mechanism of Phytoremediation: Phytosequestration, Rhizodegradation, hytoextraction, Phytodegradation, Phytovolatilization, Evapotranspiration	**10//25%**
III	Phytoremediation of inorganics: types of inorganic pollutants (heavy metals, metalloids, etc), plant uptake, translocation mechanisms for inorganics, plant accumulation, biotransformation, tolerance mechanisms for inorganics construction of a wetland for metal cleanup, genetic engineering of plant trace element metabolism. Phytoremediation of organics: types of organic pollutants, mechanisms involved in plant uptake, translocation, degradation of organics, role of plant and microbial enzymes .	**10/25%**
IV	Soil Plant Microbe Interaction: rhizoremediation, Rhizosphere Ecology, root exudates and their role in rhizosphere, quorum sensing, metal transformation, metal	**10/25%**

	immobilization, degradation of organics .Mycorrhizal Fungi as helping agents in "phytoremediation of degraded and contaminated soils	

Text Books/ Reference Books:

- Tsao, D.T. Phytoremediation: Advances in Biochemical Engineering Biotechnology. 151 edition, Springer. 2003
- Todd, A.A.Bioremediation through Rhizosphere Technology. 15th edition, An American Chemical Society Publication. 1994.
- Mackova, Martina,Dowling, David,Macek, Tomas. Phytoremediation and Rhizoremediation. Springer. 2006

Course Outcome:

CO1: To biological mechanisms involved in pollutant uptake, accumulation and transformation.

CO2: To basic insight into plant-microbe interactions involved in phytoremediation, the effects of soil properties and environmental conditions, and risk assessment.

CO3: To recognize different sources of contamination of the environment.

CO4: To understand mechanisms of pollutant uptake by plants and their phytotoxic effects.

CO5: To understand important role of plants in conservation of the environment, and will be able to apply their knowledge

MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES

	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**H**	**H**	**L**	**L**	**H**		**H**		**H**		**H**	**H**
CO2	**H**	**H**	**H**	**L**	**H**	**M**	**H**				**H**	**H**
CO3	**H**		**M**		**L**	**H**	**H**	**L**		**L**		**M**
CO4	**L**	**M**	**L**	**M**	**L**		**H**		**M**	**L**	**M**	**L**
CO5	**H**	**H**				**M**	**L**	**L**			**L**	**H**

H = Highly Related; M = Medium; L = Low