

COURSE HANDOUT (PART II)

In addition to part I (General Handout for all courses appended to the Timetable), this portion gives further specific details regarding the course.

Course No. : **BIO G544**
Course title : **Bioremediation & Biometallurgy**
Instructor-in-charge : **S. K. VERMA**
Co-instructor : **Suresh Gupta**

1. Scope and objective of the course:

The course will deal with the applications of microbial metabolism for removal of toxic material from environmental sample and recovery of metals from low grade ore. The students will be given an exposure to metal- microbe interaction, comparison of conventional and microbe based processes of treating toxic waste material. The different steps involved in bioremediation processes such as preparation of biomass through genetic manipulations, immobilization, batch or continuous processes. The applications of microbes in bioleaching process and recovery of copper, gold and nickel will be discussed with the help of case studies.

2. Text Book:

Crawford, Ronald L, Don L Crawford: Bioremediation: Principles and Applications, CUP 2005

3. Course Plan:

Lec #	Learning Objectives	Topics to be covered	Reference
1-4	The nature and composition of Industrial waste.	Sources and type of wastes, Industrial wastes, Metal contaminated sites in India, Composition of different type of wastes, Case studies.	Review articles and lecture note
5-8	Microbial metabolism & cultivation techniques	Introduction of energy generation pathways, biochemical reactions involved in biosorption and bioremediation, microbial culture techniques.	Review articles and lecture note
9-12	Biomass selection, strain modification and mass cultivation	Criteria for selection of biomass for environmental purposes, development and characterization of mutants, large scale cultivation of microbes	Review articles and lecture note
13-14	Immobilization techniques	Need to immobilize microbes, characterization of different matrices, techniques of immobilization.	Review articles and lecture note
15-20	Bioremediation process and optimization	Introduction, Process analysis, Factor influencing bioremediation process, Different type of reactor systems, Performance evaluation of bioreactor, Design consideration of biofilter column, Pilot plant case study, Kinetic and growth kinetic models, Mathematical modeling, Various research papers.	Review articles and lecture note

21-22	metal- Microbe interactions	Metal requirement for growth, mechanism of metal toxicity, development and mode of metal resistance in microbes, use of resistant organism in biosorption and bioleaching	Review articles and lecture note
23-26	Biometallurgical processes	Introduction to bioleaching process, Microorganisms, Bioleaching mechanism, Factors influencing bioleaching, Laboratory and industrial leaching techniques, Applications	Review articles and lecture note
27-33	Process optimization for ore degradation	Introduction, Optimization of various parameters for bioremediation and bioleaching, Development of management model for optimization, Case studies.	Review articles and lecture note

Lab Exercise:

1. Growth curve and generation time of given bacteria
2. Metal toxicity in bacteria
3. Immobilization of microbes
4. Biosorption of metal by bacteria
5. Bioleaching of copper ore
6. Isolation of microbe from natural habitat

4. Evaluation Scheme:

Component	Duration	Weight (%)	Date and Time	Remarks
MID-SEM exam	90 Min	25	17/3 4:00- 5:30 PM	CB
Assignment(s)		10	To be announced	
Seminar		10	To be announced	
Laboratory Assignment		20	To be announced	CB
Comprehensive Exam	3 hrs	35	11/5 AN	Partly OB

5. Chamber Consultation Hours: Wed 5.00 PM

6. Notices: All course notices will be displayed in the notice board of Biological Sciences Group.

7. Make Up Policy: Prior permission is required.

**Instructor-in-charge
BIO C332**