

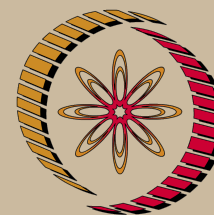
Metals Biotechnology - Web course

COURSE OUTLINE

Introduction to microbiology relevant to metals biotechnology – Biology-Materials interface – Biomaterials processing – Biogenesis of minerals and metals - History, status and developments in biohydrometallurgy – Bioleaching mechanisms – Metal toxicity and tolerance in *Acidithiobacillus ferrooxidans* – Biohydrometallurgy of copper, zinc and nickel – Biohydrometallurgy of uranium – Biotechnology for gold – Biomineralization and bioprocessing of ocean manganese nodules – Bioprocessing of industrial wastes – Electrochemical aspects of bioleaching – Electrobioleaching – Biomineral beneficiation of sulfide, oxide and industrial minerals – Biofouling, biocorrosion and biomaterials – Acid mine drainage and bioremediation in mining – Experimental and research techniques in metals biotechnology.

COURSE DETAIL

Module	Sl. No. and topic	Hours
Module 1	Microbiology, mechanisms and methods in metals biotechnology <ul style="list-style-type: none"> Lecture 1: Biology – materials interface and biomaterials processing. Lecture 2: Biogenesis of metals and minerals. Lecture 3: History and methods in biohydrometallurgy. Lecture 4: Microorganisms in biohydrometallurgy. Lecture 5: Reactor bioleaching and developments in bioleaching of concentrates Lecture 6: Bioleaching mechanisms. Lecture 7: Bacterial attachment to minerals. Lecture 8: Metal toxicity in leaching bacteria. Lecture 9: Development of metal-tolerant <i>Acidithiobacillus ferrooxidans</i>. 	9
Module 2	Biohydrometallurgy of base metal sulfides <ul style="list-style-type: none"> Lecture 10: Biohydrometallurgy of copper – general principles, mechanisms and microorganisms. Lecture 11: Biohydrometallurgy of copper – dump and heap leaching. Lecture 12: Biohydrometallurgy of copper – modern developments. Lecture 13: Bioleaching of nickel from sulfides and laterites. Lecture 14: Heap bioleaching technology for nickel. Lecture 15: Bioleaching of zinc sulfide ores and concentrates. 	6
Module 3	Biohydrometallurgy of nuclear and precious metals <ul style="list-style-type: none"> Lecture 16: Biohydrometallurgy of uranium – Microorganisms and mechanisms. Lecture 17: Biohydrometallurgy of uranium – Dump, heap and insitu leaching. Lecture 18: Biohydrometallurgy of uranium – Industrial 	6



NP-TEL

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Metallurgy and Material Science

Pre-requisites:

Basic knowledge of microbiology, chemistry and metallurgy. Mineralogy and Extractive metallurgy of ferrous and nonferrous metals.

Coordinators:

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	<p>aspects and remediation.</p> <ul style="list-style-type: none"> • Lecture 19: Biotechnology for gold – Biogenesis, microorganisms and gold nanobiotechnology. • Lecture 20: Biotechnology for gold – Biooxidation of refractory sulfidic concentrates. • Lecture 21: Biotechnology for gold – Recent developments. 	
Module 4	<p>Bioprocessing of unconventional resources</p> <ul style="list-style-type: none"> • Lecture 22: Biomineralization and bioprocessing of ocean ferromanganese nodules. • Lecture 23: Bioprocessing of industrial wastes 	2
Module 5	<p>Electrochemical aspects of bioleaching</p> <ul style="list-style-type: none"> • Lecture 24: Electrochemistry of sulfide minerals will respect to bioleaching. • Lecture 25: Galvanic and electrobioleaching of sulfide minerals • Lecture 26: Electrobioleaching for mixed sulfides and ocean Nodules 	3
Module 6	<p>Biomineral beneficiation</p> <ul style="list-style-type: none"> • Lecture 27: Principles governing microbe-mineral interfacial phenomena. • Lecture 28: Biobeneficiation of sulfide minerals using Acidithiobacillus bacteria. • Lecture 29: Biobeneficiation of sulfide minerals using Paenibacillus polymyxa. • Lecture 30: Biobeneficiation of iron ores – <i>Bacillus subtilis</i>, <i>SRB</i> and yeasts. • Lecture 31: Biobeneficiation of iron ores using <i>Paenibacillus polymyxa</i>. • Lecture 32: Alumina separation and environmental control in iron • Lecture 33: Biobeneficiation of industrial minerals. 	7
Module 7	<p>Biofouling, biocorrosion and biomaterials</p> <ul style="list-style-type: none"> • Lecture 34: Microorganisms in biofouling and biocorrosion. • Lecture 35: Biofilms and general mechanisms in biocorrosion • Lecture 36: Biocorrosion and biofouling – Mechanisms, failure analysis and control. • Lecture 37: Biomaterials and human implants. 	4
Module 8	<p>Microbiological aspects of environmental pollution and control</p> <ul style="list-style-type: none"> • Lecture 38: Acid mine drainage – Mechanisms and control • Lecture 39: Bioremediation technologies in mining • Lecture 40: Industrial aspects and in situ remediation. • Lecture 41: Experimental determination of acid mine drainage. • Lecture 42: Bioremediation using Sulfate – Reducing – Bacteria – Copper, iron, zinc and arsenic. 	5
Module 9	<p>Laboratory and research techniques in metals biotechnology</p>	

	<ul style="list-style-type: none"> • Lecture 43: Laboratory experiments in metals biotechnology – I • Lecture 44: Laboratory experiments in metals biotechnology – II • Lecture 45: Laboratory experiments in metals biotechnology – III 	3
	Total	45

References:

1. G. Rossi, Biohydrometallurgy, Mc Graw-Hill, Book company, New York (1990).
2. J. Barrett, M. N. Hugles, G. I. Karavaiko and P.A. Spencer, Metal extraction by bacterial oxidation of minerals, Ellis Horwood (NY) (1993).
3. D. E. Rawlings, Biomining (Theory, microbes and industrial processes), Springer (1997).
4. D. E. Rawlings and B. D. Johnson, Biomining, springer (2006).
5. H.L. Ehrlich, Geomicrobiology, Marcel-Dekker, NY, (1996).
6. K.A. Natarajan, Microbes, minerals and environment, Geological survey of India, Bangalore, 1998.
7. S.K. Kawatra and K.A. Natarajan, "Mineral Biotechnology- Microbial Aspects of Mineral Beneficiation, Metal Extraction, And Environmental Control", published by SME, Littleton, CO (USA) 2001.
8. S.Mann, Biomimetic materials chemistry, VCH, UK, 1996.
9. H. L. Ehrlich and C. L. Brierley, Microbial mineral recovery, Mc-Graw Hill, NY, (1990).
10. J.D.A.Miller, Microbial aspects of metallurgy, Medical and Tech. Pub. Co., Lancaster (1971).
11. S.W. Borenstein, Microbiologically influenced corrosion handbook, Woodhead pub. Ltd., Cambridge (1994).
12. References from computer WEB.
13. Proceedings of International Biohydrometallurgy Symposium (IBS)-Published once in two years.