

Non-ferrous Extractive Metallurgy - Video course

COURSE OUTLINE

The course will discuss the theoretical and practical aspects of extraction of nonferrous metals. Starting with a brief survey of the early trends in metal extraction, the lectures will go on to present, within a logical, physico-chemical framework, the fundamental principles first.

The various methods will be considered for beneficiation, extraction and refining of nonferrous metals. The course will highlight the energy and environmental aspects of extraction processes. Modern developments in technology will also be discussed.

A distinguishing feature is that the metals are dealt with in groups - their modes of occurrence being the basis of their grouping - so as to emphasize the general similarities of extraction and the techniques needed for individual metals.

COURSE DETAIL

Sl. No	Topic	Hours
1.	Early developments in metal extraction (Introduction, discovery of metals and their importance, important landmarks, nonferrous metals in Indian history, uses of nonferrous metals)	2
2.	Sources of nonferrous metals (Sources in land and sea, exploration methods, methods of beneficiation, nonferrous metals wealth in India)	1
3.	Principles of metals extraction, (Thermodynamic principles, homogeneous and heterogeneous	5



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Metallurgy and Material Science

Pre-requisites:

Undergraduate chemistry, mathematics and basic thermodynamics

Hyperlinks:

Will be given as video lecture progresses and will be embedded in web version

Coordinators:

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	reactions, Ellingham diagrams, kinetic principles, principles of electro-chemistry)	
4.	General methods of extraction, (Pyro-metallurgy – calcinations, roasting and smelting, Hydrometallurgy – leaching, solvent extraction, ion exchange, precipitation, and electrometallurgy – electrolysis and electro-refining)	4
5.	General methods of refining, (Basic approaches, preparation of pure compounds, purification of crude metal produced in bulk)	4
6.	Extraction of metals from oxide sources, (Basic approaches and special features of specific extraction processes, extraction of metals such as magnesium, aluminum, tin and ferro-alloying elements, production of ferro alloys.	7
7.	Extraction of metals from sulphide ores, (Pyro-metallurgy and hydro-metallurgy of sulphides, production of metals such as copper, lead, zinc, nickel etc.)	7
8.	Extraction of metals from halides, (Production of halides and refining methods, production of reactive and reactor metals. Methods of extraction of metals such as titanium, rare earths, uranium, thorium, plutonium, beryllium, zirconium etc.)	7
9.	Production of precious metals (Methods applied for gold, silver and pt. group of metals)	1
10.	Secondary metals and utilization of wastes, Energy and environmental issues in nonferrous metals extraction	3

References:

1. Extraction of nonferrous metals, H.S. Ray, R. Sridhar and K.P. Abraham Affiliated East West Press Pvt Ltd., New Delhi (2007).
2. W.H. Dennis, Extractive Metallurgy, Philosophical Library, New York (1965)
3. F. Habashi, Principles of Extractive Metallurgy, Vol.1, Gordon and Breach, New York (1969).
4. T. Rosenqvist, Principles of Extractive Metallurgy, McGraw Hill, New York (1983)
5. J.L. Bray, Nonferrous production metallurgy, Wiley, New York(1954)
6. R.D. Pehlke, Unit processed in extractive metallurgy, Elsevier, Amsterdam (1082)
7. H.S. Ray and A. Ghosh, Principles of extractive metallurgy, Wiley Eastern Ltd., New Delhi (1991)
8. Introduction to melts - molten, salts and slags, Allied Pub. Pvt. Ltd., New Delhi (2006)
9. H.S. Ray, B.P Singh and Sarama Bhattacharjee, Energy in minerals and metallurgical processes, Allied Publishers Ltd, New Delhi (2005)