

Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NGLD309	Archaeometallurgy	3	0	0	3

Course Objective
Understanding the fundamentals of metallurgy and metal science through the study of historical, archaeological, and artistic metal artefacts, with emphasis on critical mineral extraction and ancient technological developments. The aim is to help students understand ancient metallurgical techniques, their cultural significance, and their role in society. It also provides a foundation for understanding the relationship between metal production, resource utilisation, and long-term industrial sustainability in the Anthropocene.
Learning Outcomes
Upon completion of the course, students will be able to understand: <ul style="list-style-type: none"> • Understand the significance of metallurgy in human history and its relevance to archaeological interpretation. • Explain ancient metallurgical techniques and evaluate their potential for future critical metal extraction from primary and secondary resources. • Relate historical metallurgical practices to modern concepts of critical minerals, resource sustainability, and technological development.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1.	Definition, scope, and interdisciplinary nature of archaeometallurgy. Metals as archaeological materials: properties, corrosion, and preservation. Introduction to chronological framework of metallurgy: Chalcolithic (Cu) Age, Bronze Age, Iron Age, Industrial Era, Anthropocene and modern metallurgical impact. Origins of metallurgy: global overview from Asia and Europe. Role of metallurgy in technological and cultural development.	8	Understand origin and chronological development of metallurgy in India within global and long-term human history context.
2.	Ore formation and identification, ancient mining techniques: Chalcolithic, Bronze Age, and Iron Age mining traditions. Indian ancient mining regions: Khetri Copper Belt, Iron ore mining in Central and South India, Global ancient mining examples, Smelting technologies and furnaces. Slag: formation, types, and archaeological interpretation. Introduction to industrial archaeology and heritage: Industrial Era metallurgical sites, Colonial and early modern mining heritage in India.	8	Students will be able to identify raw materials and explain ancient mining and smelting technologies using archaeological evidence.
3.	Alloying technologies through time: Copper metallurgy, Bronze metallurgy, Iron metallurgy, Brass production, Early steel production, Manufacturing techniques, Casting techniques. Global comparisons: Asia, Africa, Europe.	6	Able to describe ancient metal production and manufacturing techniques and recognise their archaeological evidence.
4.	Identification of slag, crucibles, furnaces, and molds. Excavation, documentation, and sampling methods. Introduction to scientific analytical techniques: Microscopy, Chemical analysis. Interpretation of archaeometallurgical data with case studies.	6	Identify metallurgical remains and understand basic scientific methods used in archaeometallurgical analysis.
5.	Impetus for Future Metallurgy-Lessons from Ancient Metallurgy: Development of metallurgy and its socio-economic context in India, studied in chronological order: Chalcolithic copper metallurgy, Bronze Age metallurgy, Iron Age metallurgy, Early Historic metallurgy, and early steel production (Wootz steel). Global Developments: Metallurgical advancements in China, Africa, and Europe. Industrial Era: industrial-scale metal production and associated social transformation.	8	Students will be able to develop understanding on how early use of metals shaped modern human society and its trajectory.

	Anthropocene Perspective: Large-scale metal production, human impact on Earth systems, and the socio-economic and environmental aspects of metal production.		
6.	Resource procurement, mineral economics and trade in ancient India and world, Metal resource zones and exchange networks, Environmental impact of ancient metallurgy, Archaeological perspectives of metals on sustainability and resource management, Relevance of ancient metallurgy to present-day resource challenges.	6	Connect ancient metallurgical practices to modern issues of critical minerals, sustainability, and resource management.
	Total Classes	42	

Textbooks:

1. Hauptmann, A., 2020. *Archaeometallurgy – Materials Science Aspects*. Springer International Publishing.
2. Carrizo, P.S. ed., 2021. *Reverse Engineering of Ancient Metals*. Springer International Publishing.

Reference Books:

1. Tripathi, V., 1998. *Archaeometallurgy in India*. The University of Michigan Publishing.
2. Singh, R.N., 2007. *Aspects of Archaeometallurgy in South and South-East Asia*. the University of Michigan Publishing.
3. Dungworth, D., 2015. *Archaeometallurgy: Guidelines for Best Practice*. Historic England.