Department of Earth Sciences
Indian Institute of Technology Kanpur

Proposal for a new course

1. Course No: ES4XX

2. Course title: Geology of critical minerals

3. Department: Earth Sciences

4. Proposing Instructor: Dr. Boddepalli Govindarao

5. Units: 3-0-0-0 (9 credits)

6. Course Type: Departmental Elective (UG)

7. Prerequisite: Basics of ore geology

8. Other Interested Faculty: Dr. Anupam Banerjee

Course Description

Critical minerals are important for modern society because of their everyday use in domestic applications, electronics, military, and the sustainable development of green energy technologies. Despite their low crustal elemental abundances, ranging from parts per billion to less than a hundred parts per million, certain geological processes concentrate these elements into economically viable deposits. Understanding how these minerals concentrate on the earth's crust is important for effective mineral exploration, supply security and sustainable extraction. This course thus offers in-depth knowledge of critical mineral occurrences, formation, distribution and strategies for their exploration. The topics related to metal extraction and processing methods, challenges connected to metal mining and its impact on the environment, and strategies adopted by mining industries and government to mitigate the adverse effects of mining on the environment will also be discussed.

Course Contents	Suggested number of lectures
Introduction, definition and classification of critical minerals, applications of critical minerals, the cycle of metals and minerals, status of global critical minerals, critical minerals assessment for India, factors impacting criticality, geological assessment and consideration of supply and demand, the mining industry and the supply of critical minerals.	6
Mineralogy/petrography, occurrence and distribution of key critical and strategic minerals of antimony, beryllium, bismuth, cadmium, cobalt, copper, gallium, germanium, graphite, hafnium, indium, lithium, molybdenum, niobium, nickel,	10

Mineralogy/petrography, occurrence and distribution of key critical and strategic minerals of platinum group elements, phosphorous, potash, rare earth elements, rhenium, selenium, silicon, strontium, tantalum, tellurium, tin, titanium, tungsten, vanadium, zirconium, gold, silver, chromium, manganese	13
Critical mineral exploration strategies, processing and beneficiation techniques. factors influencing critical mineral processing selection	8
Social and environmental impacts of mining and processing, strategies to minimize the environmental impact of mining	3
Total number of lectures	40

Recommended Books:

- Rankin, W. J. (2011). Minerals, metals and sustainability: meeting future material needs. CSIRO publishing
- Walter L. Pohl, Economic Geology-Principles and Practices, Wiley-Blackwell Publisher, Chichester, UK, 2011.
- Gunn, G. (Ed.). (2014). Critical metals handbook. John Wiley & Sons
- Neukirchen, F., and Ries, G. (2020). The World of Mineral Deposits: A Beginner's Guide to Economic Geology. Springer Nature
- Recently published research articles

B. Govinda Rao

Dated: 13h February 2025 Proposer: Dr. Boddepalli Govindarao

Dated: DUGC/DPGC Convener, ES

The course is approved/ not approved

Chairman, SUGC/SPGC

Dated:_____