ΜΟΔΙΠ
ΜΟΝΑΔΑ ΔΙΑΣΦΑΛΙΣΗΣ ΠΟΙΟΤΗΤΑΣ Α.Π.Θ.

Critical raw materials

1. GENERAL			
SCHOOL	Faculty of Sciences in collaboration with Faculty of Engineering, Aristotle University of Thessaloniki		
DEPARTMENT	Materials Science and Engineering		
LEVEL OF STUDIES	ISCED level 7 (5-year Integrated Master's programme) ISCED level 6 (4-year BSc programme)		
COURSE CODE	MSEN 813	**SEMESTER**	8th Semester
COURSE TITLE	**Critical raw materials**		
TEACHING ACTIVITIES Lectures, tutorials/problem sessions, laboratory/computer exercises (where applicable), case studies and guided self-study.		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
		4 (3L + 1T)	6
COURSE TYPE	Scientific area / General knowledge		
PREREQUISITES	Basic Chemistry and Materials Science. Recommended: Materials Circular Economy and LCA.		
TEACHING AND EXAMINATION METHODS	Lectures and tutorials; case studies on supply risk and substitution; final written exam and short policy/technical brief.		
COURSE OFFERED TO ERASMUS STUDENTS	Yes (taught in English, subject to minimum enrollment).		
COURSE URL	https://elearning.auth.gr/course/view.php?id=xxxxx		

2. LEARNING OUTCOMES	
Learning Outcomes	• Define 'critical raw materials' and explain criticality drivers (economic importance, supply risk). • Describe the raw-material value chain from exploration to processing, manufacturing, and end-of-life. • Analyze major demand drivers (energy transition, electronics, mobility) and associated materials constraints. • Evaluate strategies for criticality mitigation: substitution, efficiency, recycling, and diversification. • Interpret basic indicators and datasets relevant to supply chains, geopolitics, and sustainability. • Communicate evidence-based assessments of CRM-related risks and opportunities.
General Skills	• Interdisciplinary reasoning (materials + economics + policy) • Critical reading of reports and datasets • Structured argumentation and brief writing • Awareness of ethics and sustainability implications

3. COURSE CONTENT

- Criticality concepts and assessment frameworks; key indicators and data sources.
- Raw materials value chain: mining, beneficiation, refining, materials production, manufacturing, use, end-of-life.
- Demand drivers and technology dependencies (batteries, magnets, photovoltaics, catalysts, semiconductors).
- Supply concentration, geopolitics, trade, and resilience concepts.
- Environmental and social aspects of raw materials extraction and processing (overview).
- Substitution and material efficiency strategies; design for reduced criticality.
- Recycling and urban mining; secondary supply and constraints.
- Policy and regulation overview (EU critical raw materials concepts; indicative global perspectives).
- Case studies and student briefs on selected critical materials.

4. LEARNING & TEACHING METHODS - EVALUATION

Teaching method	Face-to-face. Lectures and guided discussions of case studies and datasets; short student presentations.
Use of ICT	E-learning for resources; use of public datasets and dashboards (where available); spreadsheets for simple criticality indicator calculations and visualization.
Teaching organization	The supervised and unsupervised workload per activity is indicated below (total workload complies with ECTS standards).
Student evaluation	Assessment language: English. Methods: written final exam (60%), individual short brief/report (25%), quizzes/participation (15%). Students are informed via the course guide and e-learning announcements.

Activity	Workload/semester (hours)
Lectures	39
Tutorials / seminars	13
Short brief / case study	16
Independent study	64
Exam preparation	16
Final written exam	2
Total	**150**

5. SUGGESTED BIBLIOGRAPHY

EUDOXUS

To be specified in EUDOXUS.

Additional bibliography for study

- Selected EU and international reports on critical raw materials (updated annually/periodically).
- Academic review papers on criticality, supply chains, and substitution strategies.
- Selected online course materials (indicative): TU Delft / EIT RawMaterials learning resources.