ΜΟΝΑΔΑ ΔΙΑΣΦΑΛΙΣΗΣ ΠΟΙΟΤΗΤΑΣ Α.Π.Θ.

Waste Valorization and Advanced Recycling Technologies

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 812	**SEMESTER**	8th Semester
COURSE TITLE	**Waste Valorization and Advanced Recycling Technologies**		
TEACHING ACTIVITIES Lectures, tutorials/problem sessions, laboratory/computer exercises (where applicable), case studies and guided self-study.		**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
		4 (2L + 2Lab/Comp)	6
COURSE TYPE	Scientific area / Skill development		
PREREQUISITES	Materials Circular Economy and LCA (recommended); basic Chemistry and Materials Science.		
TEACHING AND EXAMINATION METHODS	Lectures and case studies; lab/computer sessions on recycling flows and process routes; project-based assessment; final exam.		
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	• Describe valorization routes for key waste streams and their links to material cycles and quality. • Differentiate mechanical, thermal, chemical, and bio-based recycling routes and identify applicability limits. • Understand basic process flows for metals, polymers, glass, and electronic waste recycling. • Evaluate trade-offs between recycling efficiency, product quality, energy use, and emissions. • Recognize the role of policy, standards, and supply chains in enabling high-value recycling. • Propose a recycling/valorization strategy for a selected waste stream supported by data and reasoning.
General Skills	• Systems thinking across the value chain • Data interpretation and scenario comparison • Teamwork on multidisciplinary case studies • Communication to technical and non-technical audiences

3. COURSE CONTENT

- Waste streams and secondary raw materials: definitions, quality, and contamination issues.
- Mechanical recycling: sorting, size reduction, separation methods; polymer reprocessing limitations.
- Thermal and chemical recycling routes (overview) including depolymerization and solvent-based processes.
- Metals recycling: collection, shredding, pyrometallurgy and hydrometallurgy basics (overview).
- E-waste and battery recycling: critical material recovery concepts (overview).
- Construction and demolition waste; glass and ceramics recycling (overview).
- Waste-to-materials pathways: upcycling, composites, fillers, and circular product design links.
- Techno-economic and environmental assessment links (integration with LCA concepts).
- Case studies and a team project on a selected waste valorization pathway.

4. LEARNING & TEACHING METHODS - EVALUATION

Teaching method	Face-to-face. Lectures, computer/workshop sessions, and project-based learning with case studies.
Use of ICT	Computer labs using datasets (material flow, recycling rates) and simple modelling tools; e-learning for resources; collaborative tools for group project development.
Teaching organization	The supervised and unsupervised workload per activity is indicated below (total workload complies with ECTS standards).
Student evaluation	Assessment language: English. Methods: team project/report and presentation (45%), written final exam (35%), quizzes/short assignments (20%). Students are informed via the course guide and e-learning announcements.

Activity	Workload/semester (hours)
Lectures	26
Computer labs / workshops	26
Team project and report	30
Independent study	50
Exam preparation	16
Final written exam	2
Total	**150**

5. SUGGESTED BIBLIOGRAPHY

EUDOXUS

To be specified in EUDOXUS.

Additional bibliography for study

- Relevant review papers and reports on recycling technologies (provided by the instructor).
- EU/JRC and international guidance documents on waste management and recycling (selected).
- Selected materials flow and circular economy references (indicative): TU Delft waste and critical materials learning materials.

- Handbook chapters on metals and polymer recycling (selected).