Fundamentals of Additive Manufacturing

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 711	**SEMESTER**	7th Semester
COURSE TITLE	**Fundamentals of Additive Manufacturing**		
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)	6
COURSE TYPE	Scientific area / Skill development		
PREREQUISITES	Introduction to Materials Science and Engineering; basic CAD familiarity recommended.		
TEACHING AND EXAMINATION METHODS	Lectures plus laboratory/workshop sessions; team project on Design for Additive Manufacturing (DfAM); final exam and project deliverables.		
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 major AM process families (polymer, metal, ceramic) and their process-structure-property relationships. • Select AM processes based on part requirements, material constraints, and economic considerations. • Apply Design for Additive Manufacturing (DfAM) rules for geometry, supports, tolerances, and anisotropy. • Identify typical AM defects (porosity, lack of fusion, residual stresses) and propose mitigation strategies. • Plan post-processing routes (heat treatment, HIP, machining, surface finishing) appropriate to the process. • Execute a basic AM workflow from design to build preparation to evaluation within a team project.
General Skills	• Hands-on engineering practice and safety awareness • Teamwork and project management • Digital skills (CAD, slicing/build preparation) • Critical evaluation of emerging technologies

3. COURSE CONTENT

- AM overview: opportunities, limitations, and industrial adoption.
- Polymer AM: material extrusion, vat photopolymerization, powder bed fusion (polymers).
- Metal AM: laser/e-beam powder bed fusion, directed energy deposition; feedstocks and machines.
- Ceramic and composite AM (overview) and emerging multi-material printing.
- DfAM fundamentals: topology optimization concepts (overview), lattice structures, support strategies.
- Process-structure-property: thermal histories, anisotropy, microstructure, residual stresses.
- Quality assurance: in-situ monitoring (overview), inspection, mechanical testing, standards overview.
- Post-processing: stress relief, heat treatment, HIP, machining, surface finishing.
- Economics and sustainability of AM; case studies and a team project.

4. LEARNING & TEACHING METHODS - EVALUATION

Teaching method	Face-to-face. Lectures, hands-on lab/workshop sessions, and a team design-and-build project.
Use of ICT	CAD and build preparation software in lab sessions; e-learning for tutorials and submissions; use of simulation/monitoring datasets (where available).
Teaching organization	The supervised and unsupervised workload per activity is indicated below (total workload complies with ECTS standards).

Activity	Workload/semester (hours)
Lectures	26
Laboratories / workshops	26
Team project (design-build-evaluate)	30
Independent study	50
Exam preparation	16
Final written exam	2
Total	**150**

Student evaluation	Assessment language: English. Methods: final exam (35%), team project deliverables (report/design files/print evaluation) (45%), quizzes/short assignments (20%). Students are informed via the course guide and e-learning announcements.

5. SUGGESTED BIBLIOGRAPHY

EUDOXUS

To be specified in EUDOXUS.

Additional bibliography for study

- I. Gibson, D.W. Rosen & B. Stucker, Additive Manufacturing Technologies.
- T. Wohlers (ed.), Wohlers Report (selected recent editions, where available).
- ISO/ASTM standards and guidelines for additive manufacturing (selected).

- Selected open courseware notes (indicative): MIT additive manufacturing course materials.