Summer School C1: Introduction to Materials and Quality for ALM

This Summer School “Introduction to Materials and Quality for ALM” will pilot the contents developed for O1, O2 and O3 within APTIME project. Student’s feedback from their delivery will be an important input to improve the contents developed in the project.

Module O1: Advanced Materials and Materials for ALM.

Module O2: Management and Entrepreneurship for ALM.

Module O3: Quality control and Part Validation.

Organization

Summer School C1 will include Face-to-Face lecturers and seminars during 1 week (5 working days) from the January the 24th to January the 28th. If the international situation, due to the COVID 19 pandemic, will not permit travelling or Face-to-Face activities this Summer School will be delivered remotely.

PARTICIPANTS: 24 students (4 for each APTIME partner)

12 lecturers (2 for each APTIME partner)

TOTAL HOURS: 22

MONDAY TO THURSDAY from 9:00 to 13:00	Theoretical lessons and case studies
TUESDAY TO THURSDAY from 15:00 to 17:00	Theoretical lessons and case studies
FRIDAY from 09:00 to 15:00	Technical visit

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Lectures and seminars programme.

MONDAY THE 24TH

9:00-10:45 **Summer School Welcome Presentation (UoW)**

The aim of the Summer School within the objectives of APTIME project will be presented.

11:15-13:00 **O1 Feedstock materials for ALM (Fontys)**

An introduction to characterisation of powder shape and size distribution is given and the main processes for powder fabrication will be presented. The importance of surface energy and surface quality will be shown including the importance of powder flowability. The last topic is mechanical alloying. A few simple calculations will complete the information.

15:00-17:00 Social and/or technical event. Visit to URJC facilities.

TUESDAY THE 25TH

9:00-10:45 **Mechanical characterization of materials (URJC)**

The phenomenological behaviour will be revised including the most important mechanical models for ALM materials and their relationship with their microstructure characteristics. Linear elastic, nonlinear elastic, plastic, viscoelastic and viscoplastic behavior will be considered.

11:15-13:00 **Fracture and fatigue resistance. Mechanisms of fracture observed by Scanning Electron Microscopy (SEM) (URJC)**

The concepts of Fracture Mechanics will be revised with special attention to fracture toughness and fatigue resistance (S-N curves, fatigue limit and crack propagation curves). Finally, the most relevant mechanisms of fracture for ALM materials will be presented.

15:00-17:00 **Module O2: Introduction to organisational change (SRH)**

Introduction to organisational change: understanding organizational transformation, models of organizational change, leading change and managing change. Students will learn about what is involved when a company moves to AM and how to analyse and deal with reactions to change

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WEDNESDAY THE 26TH

9:00-10:45 **Module O2: Financial aspects of AM (SRH)**

Financial aspects of AM. Students will review the necessary elements of a business plan for manufacturing. An overview of what a business plan requires, particularly costing, cost allocation, cash flow and breakeven analysis, financial projections and risk management

11:15-13:00 **Module O2: Case study: business plan (SRH)**

Case study. Students will develop a business plan for introducing AM at a small engineering company and manufacturing a part.

15:00-17:00 **Module O3: Importance and overview of quality control and part validation (UL).**

Importance and overview of quality control and part validation and its tools. Most common defects in AM (PBF) and part requirements. Pre-quality control of powder feedstock material, factors that affect the properties of AM components, characterisation and monitoring of feedstock powder based materials. Properties of powders and characterisation techniques, powder handling, safety risks, recovery and reuse of metal powder.

THURSDAY THE 27TH

9:00-10:45 **Module O3: Inspection of part quality characteristics (UL).**

Inspection of part quality characteristics by non-destructive and destructive analysis. Part quality requirements. External and internal NDT methodologies (visual, PT, CT,). Destructive testing (microscopy, mechanical testing).

11:15-13:00 **Practical session (UL, UoW and URJC).**

Case study. Students will form groups and experimentally characterise the powder feedstock material by rheology tests. Prepared parts with known history will be examined using different NDT and DT methods to evaluate the quality of final parts. At the end the students will present the results to their colleagues.

15:00-17:00 **Conclusions and Feedback (UoW)**

The main conclusions will be presented, and the participants' opinions collected.

FRIDAY THE 28TH

9:00-15:00 **Technical and social excursion to finalize the Summer School**.

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