

Module Code	MEU33EM1
Module Name	Laser Processing and Additive Manufacturing I
ECTS Weighting¹	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Dr. Moyin Otubela (otubelmv@tcd.ie) [module coordinator], Prof. Garret O' Donnell (odonnege@tcd.ie), Prof. Rocco Lupoi (lupoir@tcd.ie)
<u>Module Learning Outcomes</u> with reference to the <u>Graduate Attributes</u> and how they are developed in discipline	<p>On successful completion of this module, students should be able to:</p> <ol style="list-style-type: none"> 1. Comprehend the fundamentals of different additive manufacturing technologies, whether they are based on cold spray or metal melting. 2. Provide an appreciation for why additive manufacturing is so important to many branches of industry and how to apply additive manufacturing technology in different settings. 3. Compare against each other, the most relevant additive technologies such as Laser Powder Bed Fusion and Cold Spray. Understand involved processing parameters and advantages and challenges with implementing robotics assisted additive manufacturing methods. 4. Calculate power requirements and process performance in laser manufacturing. 5. Understand the basic working mechanisms of lasers, components, and be aware of the laser types currently available. 6. Be aware of the hazards involved in dealing with lasers and safety classification. 7. Develop and present a conceptual design solution to a precision machine operating. The specifics of this outcome will vary on a year to year basis. 8. Understanding the role of optics in laser based systems. <p>Graduate Attributes: levels of attainment</p> <p>To act responsibly - Introduced</p> <p>To think independently - Enhanced</p> <p>To develop continuously - Enhanced</p> <p>To communicate effectively - Introduced</p>

¹ [TEP Glossary](#)

Module Content

- Lasers and basic principles. Cavity design for CO₂ lasers.
- Laser cutting, drilling, and welding
- Laser surface treatments. Laser micro-manufacturing.
- Laser Powder Bed Fusion (L-PBF)
- Titanium metallurgy and heat treatment processes
- Robot Assisted Additive Manufacturing
- Thermal Spray
- Grinding and abrasive processes
- Fundamentals of welding
- Welding processes

Module Description

In high value added manufacturing industry, engineers are required to understand how mechanical systems and materials behave at length scales at the micron level. The objective of this module is to develop the student's skills and knowledge in both precision engineering and micro engineering. The module will consider selected topics in precision, micro-manufacturing, ranging from enabling technologies and processes to applications. The module is research-lead, hence the content can vary on a year to year basis. Currently, most of the module is around LASER based manufacturing, LASER-Additive Manufacturing (3D printing) with metallic materials, and related automation.

The module will require an active participation of the students.

Teaching and Learning Methods

This module is typically a small group environment with approximately 40 or less people participating. Hence the class forms the basis for discussion on topics, as well as more formal podium style lectures. Examples related in the class are often based on topical issues. Visiting lectures range from industry to visiting researchers.

Assessment Details² Please include the following: <ul style="list-style-type: none"> • Assessment Component • Assessment description • Learning Outcome(s) addressed • % of total • Assessment due date 	Assessment Component	Assessment Description	LO Addressed	% of total	Week due			
	In-class exams	3x in-class exams	1-10	60%	continuous			
	Continuous Assessment	Multiple Choice Quizzes	1-6	40%	Continuous			
Reassessment Requirements								
Contact Hours and Indicative Student Workload²	<table border="1"> <tr> <td> Contact hours: 42 Hours (33 lectures, no tutorials) </td> </tr> <tr> <td> Independent Study (preparation for course and review of materials): 39 </td> </tr> <tr> <td> Independent Study (preparation for assessment, incl. completion of assessment): 39 </td> </tr> </table>					Contact hours: 42 Hours (33 lectures, no tutorials)	Independent Study (preparation for course and review of materials): 39	Independent Study (preparation for assessment, incl. completion of assessment): 39
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Recommended Reading List	<p>Kalpakjian & Schmid, 2006, Manufacturing Engineering & Technology, Pearson pub.</p> <p>Dornfeld & Lee, 2007, Precision Manufacturing, Springer pub.</p> <p>W. Steen, Laser Material Processing.</p> <p>I. Gibson D. W. Rosen B. Stucker, 2010, Additive Manufacturing Technologies, Springer</p> <p>Journal papers recommended in class.</p>							
Module Pre-requisite								
Module Co-requisite								
Module Website								

² [TEP Guidelines on Workload and Assessment](#)

Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.

Module Approval Date

Approved by

Nicole Byrne

Academic Start Year

Academic Year of Date