Module Code	**ME5MM1**
Module Name	**Additive Manufacturing and Laser Processing**
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Assist. Prof. Rocco Lupoi (lupoir@tcd.ie), Dr. Amir Pakdel (pakdela@tcd.ie)
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On successful completion of this module, students should be able to: 1. Comprehend the fundamentals of different additive manufacturing technologies, whether they are based on photopolymer curing, ceramic sintering, 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 Selective Laser Melting and Cold Spray. Have an understanding of involved processing parameters. 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. **Graduate Attributes: levels of attainment** To act responsibly - Choose an item. To think independently - Choose an item. To develop continuously - Choose an item. To communicate effectively - Choose an item.

[1] TEP Glossary

Module Content	• Lasers and basic principles. Cavity design for CO_2 lasers. • Laser cutting, drilling, and welding • Laser surface treatments. Laser micro-manufacturing. • Micro-turning, micro-milling and micro-grinding – principles and operations • Metal, polymer, and ceramic additive manufacturing • Printing processes • Direct write technologies (meso, micro, nano) **Module Description** In high value added manufacturing industry, engineers are required to understand how mechanical systems and materials behave at length scales of microns and nanometres. The objective of this module is to develop the student's skills and knowledge in precision engineering, micro and nano-engineering. The module will consider selected topics in precision, micro and nanomanufacturing, 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 3D printing of polymeric and ceramic materials. The module will require an active participation of the students.
Teaching and Learning Methods	This module is typically a small group environment with approximately 30 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.

COVID-19 contingency statement for Module Descriptors

While the intention is to deliver all lectures and tutorials face-to-face in a classroom, there is uncertainty due to the Covid-19 situation and part or all of the module delivery may need to change to an online delivery if required by government restrictions. In the case of a possible new lockdown scenario during teaching term:

- All lectures and tutorials will be delivered online using Blackboard Collaborate Ultra. These sessions will be recorded and available for viewing via Blackboard at a later time.
- The mid-term class test and the end of semester exam will be online.

<table>
<tr><td>Assessment Details[2]
Please include the following:
• Assessment Component
• Assessment description
• Learning Outcome(s) addressed
• % of total
• Assessment due date</td><td colspan="5"><table>
<tr><td>Assessment Component</td><td>Assessment Description</td><td>LO Addressed</td><td>% of total</td><td>Week due</td></tr>
<tr><td>C40-01</td><td>Exam</td><td></td><td>100%</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Reassessment Requirements</td><td></td></tr>
<tr><td>Contact Hours and Indicative Student Workload[2]</td><td><table>
<tr><td>Contact hours: 44 Hours</td></tr>
<tr><td>Independent Study (preparation for course and review of materials):</td></tr>
<tr><td>Independent Study (preparation for assessment, incl. completion of assessment):</td></tr>
</table></td></tr>
<tr><td>Recommended Reading List</td><td>Kalpakjian & Schmid, 2006, Manufacturing Engineering & Technology, Pearson pub.

Dornfeld & Lee, 2007, Precision Manufacturing, Springer pub.

W. Steen, Laser Material Processing.

I. Gibson l D. W. Rosen l B. Stucker, 2010, Additive Manufacturing Technologies, Springer

Journal papers recommended in class.</td></tr>
<tr><td>Module Pre-requisite</td><td></td></tr>
<tr><td>Module Co-requisite</td><td></td></tr>
<tr><td>Module Website</td><td></td></tr>
<tr><td>Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.</td><td></td></tr>
<tr><td>Module Approval Date</td><td>16/07/2019</td></tr>
<tr><td>Approved by</td><td>Nicole Byrne</td></tr>
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[2] TEP Guidelines on Workload and Assessment

Academic Start Year	2020
Academic Year of Date	2020 - 2021