Module Code	**MEP55M11**
Module Name	**Nanotechnology and Additive Manufacturing II**
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Asst. Prof. 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 will be able to: 1. Gain familiarity with the principles governing the properties of nanomaterials and the factors that differentiate their behaviour from that of bulk materials. 2. Develop an understanding of the manufacturing processes used to produce nanomaterials, nanostructured surfaces, and bulk nanostructured materials. 3. Develop an understanding of nanomaterial characterisation techniques. 4. Acquire knowledge of the principles of nanotechnology, including interdisciplinary perspectives on the fabrication and application of nanoscale structures and devices. 5. Explore the transformative impact of nanomaterials and nanotechnology across various industrial sectors, including electronics, energy, medical and biomedical applications, functional surfaces, and additive manufacturing. 6. Understand the underlying principles of various additive manufacturing technologies, including those based on photopolymer curing, ceramic sintering, metal melting, and their integration with nanotechnology. 7. Compare the most relevant additive manufacturing technologies, such as Inkjet Printing, Stereolithography, Selective Laser Melting, and Fused Deposition Modelling, together with their associated processing parameters. **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

- Introduction to nanomaterials (0D, 2D, 2D, 3D), nanostructured surfaces, and nanoscale interactions
- Nanomanufacturing techniques (*mechanical milling, laser ablation, exfoliation, sputtering, electrospinning, lithography, wet chemistry, arc discharge, physical vapour deposition, chemical vapour deposition*)
- Consolidation techniques (*hot-pressing, conventional sintering, spark plasma sintering, microwave sintering, etc*)
- Nanoscale characterization techniques (*electron microscopy methods, scanning probe microscopy techniques, X-ray diffraction, various spectroscopy techniques*)
- Nanotechnology and its diverse applications (*functional surfaces, functional textile, water treatment, solar/mechanical/thermal energy conversion, energy storage, flexible electronics, health*)
- Introduction to additive manufacturing and its applications (*prototypes, vehicles, medical, electronics, food, textile*)
- Economics of additive manufacturing and nanotechnology
- Polymer, ceramic, semiconductor, nanomaterial additive manufacturing techniques

Module Description

Nanotechnology and additive manufacturing are at the forefront of technological innovation and have significant potential across a wide range of industries. Nanotechnology focuses on the manipulation of materials at the nanoscale, enabling the development of materials with novel properties and functionalities. Additive manufacturing, also known as 3D printing, transforms conventional manufacturing by building objects layer by layer. This approach offers greater design freedom, reduces material waste, and enables the precise production of complex structures. Together, nanotechnology and additive manufacturing are expanding the boundaries of modern manufacturing and supporting the development of more customised, efficient, and sustainable production methods.

This module is partially research-led; therefore, its content may vary from year to year. Students are expected to participate actively throughout the module. Attendance at lectures, tutorials, and lab sessions is mandatory, as is the submission of all work subject to continuous assessment. Unexcused absences will be penalised.

Teaching and Learning Methods	This module is taught using a combination of lectures, laboratory exercises (either on-line or in-person) and tutorial sessions. The class serves as platforms for both informal discussions on topics and more structured podium-style lectures. Examples provided during class discussions are drawn from recent topics of interest, adding relevance and context to the material.

Assessment Details[2]

Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

Assessment Component	Assessment Description	LO Addressed	% of total	Week due
Written examination	Exam	1-7	70%	Exam period
Continuous assessment	Combination of on-line & in-person labs, quizzes, group projects, and/or term reports	1-7	30%	Weeks 1-12

Reassessment Requirements

Students must pass the examination element of the module to avoid the possibility of reassessment.
Reassessment will be by examination only.

Contact Hours and Indicative Student Workload[2]

Indicative student workload (to include assessment)	133 hours
Contact hours:	33 hours Lectures; Analytical sessions; Group discussions
Independent Study (preparation for course and review of materials):	50 hours Read lecture notes and review own notes; Further reading from supplementary reading materials (e.g. textbooks and journal articles)
Independent Study (preparation for assessment, incl. completion of assessment):	50 hours Literature review for the group project; Performing experimental or analytical research; Discussion among group members; Writing; Preparation for oral or poster presentation & the final exam

[2] TEP Guidelines on Workload and Assessment

Recommended Reading List	Nanotechnology for Mechanical Engineers Gibin, Raghav & Jeetu, 2025, Routledge - Taylor & Francis Group Essentials in Nanoscience and Nanotechnology Johal & Johnson, 2018, Routledge - Taylor & Francis Group Additive Manufacturing Technologies Gibson, Rosen & Stucker, 2010, Springer Journal papers recommended in class.
Module Pre-requisite	MEU33EM1 OR MEU44B05 (Laser Processing and Additive Manufacturing I)
Module Co-requisite	N/A
Module Website	https://tcd.blackboard.com/
Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.	N/A
Module Approval Date	
Approved by	
Academic Start Year	2025
Academic Year of Date	2026/27