Module Code	MEU11E16
Module Name	Materials Science
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 1
Module Coordinator/s	Prof. Amir Pakdel (pakdela@tcd.ie)
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	Upon completion of this module, students will be able to: LO1. Identify the classes of materials, including metals, ceramics, polymers, composites, and semiconductors, and explain how their properties can be determined and exploited. LO2. Comprehend the correlation between the atomic/molecular structure of materials and their physical properties. LO3. Apply fundamental concepts of materials behaviour (such as deformation, failure mechanisms, and phase transformations) to solve basic engineering problems. LO4. Work in teams to conduct basic experimental procedures for measuring key material properties and interpreting the results. This will help develop a deeper understanding of materials behaviour, as well as enhance communication and collaboration skills. **Graduate Attributes: levels of attainment** To act responsibly - Introduced To think independently - Introduced To develop continuously - Introduced To communicate effectively - Introduced

[1] TEP Glossary

Module Content	This introductory module provides a broad foundation in materials science and engineering, focusing on the fundamental principles that govern the structure, properties, and performance of materials. The covered topics include: • Introduction to materials science and engineering, classification of materials (metals, ceramics, polymers, composites, semiconductors, nanomaterials, natural materials), materials design and selection (for mechanical, biomedical, structural, and electronic applications), environmental effects. • Atomic bonding, binding energy, crystal structures, microstructures, relationship between structure and materials properties. • Atom movements in materials (diffusion), defects in materials (e.g. point defects, dislocations) and their effects on materials properties. • Principles of mechanical behaviour of materials, including concepts like types of stress and strain, deformation, and failure (ductile fracture, brittle fracture, creep, fatigue, and wear). • Mechanical properties including strength, stiffness, ductility, hardness, toughness, and fracture toughness. • Strengthening mechanisms: solid solution strengthening, precipitation hardening, strain hardening, compositing, and heat treatment. • Solid solutions, binary phase diagrams, metallurgy of steel, iron-carbon phase diagram. • Hands-on experiments to measure materials properties.
Teaching and Learning Methods	The module includes a taught component delivered through podium lectures. Regular tutorial sessions are held to provide practice in solving problems. An experimental component is also included, where students work in teams to test the properties of materials and structures. A briefing session will be conducted beforehand to explain the required experimental procedures. The module will require an active participation of the students. Attendance at lectures, tutorials and lab sessions is mandatory, as is the submission of all work subject to continuous assessment. The module will be assessed at the end of the semester.

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
Examination	Examination	1,2,3	70	Examination Week
Continuous Assessment	Quizzes, reports on laboratory experiments and design challenges.	4	30	Various occasions

Reassessment Requirements

Reassessment will be by examination only.

Contact Hours and Indicative Student Workload[2]

Contact hours: 33 hours
Independent Study (preparation for course and review of materials): 50 hours
Independent Study (preparation for assessment, incl. completion of assessment): 50 hours

Recommended Reading List

The Science and Engineering of Materials, Askeland, Fulay, Wright

Engineering Materials 1&2: An Introduction to Properties, Applications and Design, Ashby and Jones

Any other textbook covering fundamentals of "materials science & engineering"

Module Pre-requisite

None

Module Co-requisite

None

Module Website

None

Are other Schools/Departments involved in the delivery of this module?

No other schools or departments are involved.

Module Approval Date

Approved by

Academic Start Year

September 2025

Academic Year of Date

2025/26

[2] TEP Guidelines on Workload and Assessment