

<b>Module Code</b>	MEU33B04
<b>Module Name</b>	Mechanical Engineering Materials
<b>ECTS Weighting</b>	5 ECTS
<b>Semester taught</b>	Semester 1
<b>Module Coordinator</b>	Prof. Kevin O'Kelly
<b>Module Learning Outcomes (LOs) with reference to the Graduate Attributes and how they are developed in the discipline</b>	<p>LO1. Understand different mechanism of material deformation and failure and perform calculations relating the atomic structure and microstructure of materials to deformation behaviour.</p> <p>LO2. To quantify the effects of time, temperature and environment on material properties of metals, ceramics, polymers and composites.</p> <p>LO3. Predict how material properties are affected by alloy compositions and thermo-mechanical treatment.</p> <p>LO4. Apply knowledge to selection of suitable materials for specific engineering applications.</p> <p>LO5. Understand failure in engineering components, especially its social and ethical consequences.</p> <p>LO6. To carry out practical laboratory on the manufacture and testing of composite materials.</p> <p>LO7. Carry out a technical report on material selection and performance in engineering applications.</p> <p><b>Graduate Attributes: levels of attainment</b></p> <ul style="list-style-type: none"> <li>• To act responsibly - Enhanced</li> <li>• To think independently - Enhanced</li> <li>• To develop continuously - Enhanced</li> <li>• To communicate effectively - Enhanced</li> </ul>
<b>Module Content</b>	<p>This module develops essential concepts in the selection and use of engineering materials for mechanical and biomedical applications. Various modes of failure including yield, fracture, fatigue, creep, corrosion and wear will be examined. Different types of materials (including metal alloys, polymers, ceramics and composites) and their mechanical behaviour will be explored. Material processes and environmental conditions that alter the mechanical characteristics of the materials shall be considered. This information will then be</p>

	used to select suitable materials for specific applications and determine why some materials fail under certain conditions.
<b>Detailed Syllabus</b>	<p>This module further develops material science introduced in 1<sup>st</sup> year. It introduces transient properties and material selection in design. Specifically:</p> <p>Development of mechanical behaviour to other materials</p> <ul style="list-style-type: none"> <li>• <u>Porous Materials</u>: effect of porosity on tensile, compressive, shear and bulk properties</li> <li>• <u>Composite Materials</u>: fabrication methods, effect of component properties, fibre alignment on mechanical properties</li> </ul> <p>Plastic behaviour</p> <ul style="list-style-type: none"> <li>• dislocation movement &amp; microstructure</li> <li>• solid solution strengthening (binary phase diagrams, transient diffusion)</li> <li>• heat treatments of steel</li> <li>• material selection (Ashby charts)</li> </ul> <p>Fracture</p> <ul style="list-style-type: none"> <li>• microstructural mechanisms</li> <li>• LEFM</li> <li>• EPFM (CTOD, J-integral)</li> <li>• experimental techniques (Charpy, nano-indentation)</li> </ul> <p>Fatigue</p> <ul style="list-style-type: none"> <li>• microstructural mechanisms</li> <li>• S-N curves, uncertainty and the Paris Law</li> <li>• linear and non-linear damage accumulation models</li> <li>• mean loads (Goodman, Gerber, Soderberg lines)</li> <li>• surface effects (polishing, grinding, shot peening)</li> <li>• forensic fatigue analyses</li> </ul> <p>Creep</p> <ul style="list-style-type: none"> <li>• microstructural mechanisms</li> <li>• temperature and stress models</li> <li>• design considerations</li> <li>• stress relaxation in polymers</li> </ul> <p>Corrosion</p> <ul style="list-style-type: none"> <li>• Wet and dry oxidation mechanisms (linear &amp; non linear)</li> <li>• Temperature effects</li> <li>• Stability (Pilling-Bedworth ratio)</li> <li>• Oxidation rates (CPR, current density models)</li> <li>• Design considerations (sacrificial anodes, uniform, Galvanic, crevice, intergranular, erosion corrosion)</li> </ul>

<b>Teaching and Learning Methods</b>	<p>This module is taught using a combination of lectures and tutorial sessions. The tutorial sessions are overseen by Teaching Assistants where students work in groups to develop their technical, communication and teamwork skills.</p> <p>Learning is achieved using both summative and formative methods.</p>															
<b>Assessment Details</b>	<table border="1" data-bbox="566 504 1425 761"> <thead> <tr> <th>Type</th> <th>Description</th> <th>Value</th> <th>Week due</th> </tr> </thead> <tbody> <tr> <td>A. Examination</td> <td>2 in-class tests</td> <td>50% (25% each)</td> <td>Weeks 6 &amp; 12</td> </tr> <tr> <td rowspan="2">B. Continuous Assessment</td> <td>Technical Report</td> <td>40%</td> <td>Week 10</td> </tr> <tr> <td>Laboratory</td> <td>10%</td> <td>In term</td> </tr> </tbody> </table> <p><b>IMPORTANT: Students must pass both the A and B assessment components to pass the module.</b></p>	Type	Description	Value	Week due	A. Examination	2 in-class tests	50% (25% each)	Weeks 6 & 12	B. Continuous Assessment	Technical Report	40%	Week 10	Laboratory	10%	In term
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<b>Reassessment</b>	Written Examination (100%)															
<b>Contact Hours and Indicative Student Workload</b>	<p>Contact hours: 44 (33 lectures + 11 tutorials)</p> <p>Independent Study (preparation for and review of lecture material): 22</p> <p>Independent Study (preparation for and completion of assessments): 54</p>															
<b>Recommended Reading List</b>	Engineering Materials 1 & 2, MF Ashby & DRH Jones (Butterworth- Heinemann)															
<b>Module Pre-requisites</b>	CEU11E20 Materials Applications MEU11E16 Materials Science															
<b>Module Co-requisite</b>	None															