Title: Surface Engineering

APPROVED

Module Code: MECH8032

Duration: 1 Semester

Credits: 5

NFQ Level: Advanced

Field of Study: Mechanical Engineering

Valid From: Semester 1 - 2020/21 (September 2020)

Module Delivered in 4 programme(s)

Module Coordinator: GER KELLY

Module Author: Gareth ODonnell

Module Description:
Surface engineering, allows for science and technologies to be utilised, in order to improve the overall performance of an engineered component, assembly or system. It does this by addressing such factors as corrosion, wear, bio-activation and hydrophobicity. Research and development in surface coating and surface manipulation, has resulted in specific processing techniques being developed to allow for significant performance improvements. The learning from this module is focussed on such surface engineering R&D. It will cover material processing, characterisation and surface engineering application. It will include the study of high quality published research, the fundamental principles of surface degradation, the development of surface coating techniques and familiarisation with case studies. The learning will comprise of surface engineering research and development activity, in a broad range of industry and application settings, including diagnostics, manufacturing, clinical and fundamental research to a state-of-the-art quality. Consequently, on completion, the learner shall have knowledge, know-how and competency in the area of surface engineering to an advanced level.

Learning Outcomes
On successful completion of this module the learner will be able to:

LO1 Formulate solutions to wear and corrosion mitigation challenges, in specific advanced application areas within the clinical biomedical and aero-engine industries.

LO2 Recommend advanced surface analysis techniques and equipment for use in routine and non-routine investigation of particular surface characteristics. Justify appropriate analysis methods (including sample preparation) for specific surface engineering challenges.

LO3 Consider and judge the appropriateness of advanced surface engineering processing technologies.

LO4 Detail current surface engineering applications, by validating the engineering/scientific rationale, on which a particular design approach is employed for certain applications. Aero-engine, joint replacement and clinical equipment component applications may be included.

LO5 Formulate argument for recommendation of design reasoning, related to advanced surface engineering applications.

LO6 Research and critique high quality contemporary published surface engineering research.

Pre-requisite learning
Module Recommendations
This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module.
You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named CIT module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).

No recommendations listed
**Incompatible Modules**
These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.

No incompatible modules listed

**Co-requisite Modules**
No Co-requisite modules listed

**Requirements**
This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed. You may not enrol on this module if you have not acquired the learning specified in this section.

No requirements listed

**Co-requisites**
No Co Requisites listed
**Indicative Content**

**Introduction**
General introduction to surface engineering topic and module contents.

**Wear**
Wear mechanisms, characterisation and design for mitigation.

**Surface and Coating Processes**
Thermal spray, vapour deposition [chemical & physical], plating [electro-plating, electroless-plating], thermo-chemical surface treatment, ion implantation, shot peening, vacuum systems and their application in surface engineering processes.

**Surface Characterisation**
Calo-test (ball and crater), hardness, visual and metallurgical examinations, optical and electron microscopy.

**Corrosion**
Corrosion mechanisms, characterisation and design for mitigation.

**Industrial Applications**
A broad range of industrial application described in the context of surface treatment selection and improvements achieved.

### Assessment Breakdown

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Work</td>
<td>40.00%</td>
</tr>
<tr>
<td>End of Module Formal Examination</td>
<td>60.00%</td>
</tr>
</tbody>
</table>

### Course Work

<table>
<thead>
<tr>
<th>Assessment Type</th>
<th>Assessment Description</th>
<th>Outcome addressed</th>
<th>% of total</th>
<th>Assessment Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Report</td>
<td>Thematic written reports with significant high level self-directed literature review and critique required, including a report on laboratory sample preparation experience. Expected deadlines are week 4, 8 &amp; 12.</td>
<td>2,3,4,5</td>
<td>30.0</td>
<td>n/a</td>
</tr>
<tr>
<td>Presentation</td>
<td>Verbal presentation/interview based on a given surface engineering topic/challenge with an emphasis on a specific application area.</td>
<td>2,3,4,5</td>
<td>10.0</td>
<td>Week 12</td>
</tr>
</tbody>
</table>

### End of Module Formal Examination

<table>
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<tr>
<td>Formal Exam</td>
<td>Written examination covering all module learning areas.</td>
<td>1,2,3,4,5</td>
<td>60.0</td>
<td>End-of-Semester</td>
</tr>
</tbody>
</table>

### Reassessment Requirement

**Repeat examination**

Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

The institute reserves the right to alter the nature and timings of assessment.
# MECH8032: Surface Engineering

## Module Workload

### Workload: Full Time

<table>
<thead>
<tr>
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<th>Hours</th>
<th>Frequency</th>
<th>Average Weekly Learner Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Delivery of detailed support learning material to form the basis of critical analysis in the field of practical surface engineering.</td>
<td>3.0</td>
<td>Every Week</td>
<td>3.00</td>
</tr>
<tr>
<td>Lab</td>
<td>Experimental laboratory and published research critique sessions.</td>
<td>2.0</td>
<td>Every Second Week</td>
<td>1.00</td>
</tr>
<tr>
<td>Independent &amp; Directed Learning (Non-contact)</td>
<td>Study and critique of both specified and self-identified published surface engineering literature resulting in written report submission deliverables.</td>
<td>3.0</td>
<td>Every Week</td>
<td>3.00</td>
</tr>
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</table>

Total Hours: 8.00  
Total Weekly Learner Workload: 7.00  
Total Weekly Contact Hours: 4.00

### Workload: Part Time

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### Module Resources

#### Recommended Book Resources


This module does not have any article/paper resources

#### Other Resources

- Website: NPL *Guides to Good Practice in Corrosion Control*  
  [https://www.npl.co.uk/electrochemistry/corrosion-guides](https://www.npl.co.uk/electrochemistry/corrosion-guides)
- Website: NPL *Ball cratering or micro-abrasion wear testing of coatings GPG57*  
  [https://www.npl.co.uk/gpgs/ball-cratering-or-micro-abrasion-wear-testing](https://www.npl.co.uk/gpgs/ball-cratering-or-micro-abrasion-wear-testing)
- Website: Teer Coatings  
  [http://www.teercoatings.co.uk/](http://www.teercoatings.co.uk/)
- Website: NASA Technical Reports Server  
  [https://ntrs.nasa.gov/search.jsp?R=19980218923](https://ntrs.nasa.gov/search.jsp?R=19980218923)
  [https://ntrs.nasa.gov/search.jsp?R=19980218857](https://ntrs.nasa.gov/search.jsp?R=19980218857)
  [https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19980218924.pdf](https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19980218924.pdf)
<table>
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<tr>
<th>Programme Code</th>
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<th>Semester</th>
<th>Delivery</th>
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</thead>
<tbody>
<tr>
<td>CR_EBIOM_8</td>
<td>Bachelor of Engineering (Honours) in Biomedical Engineering</td>
<td>5</td>
<td>Elective</td>
</tr>
<tr>
<td>CR_EBIOM_8</td>
<td>Bachelor of Engineering (Honours) in Biomedical Engineering</td>
<td>7</td>
<td>Elective</td>
</tr>
<tr>
<td>CR_EMECH_8</td>
<td>Bachelor of Engineering (Honours) in Mechanical Engineering</td>
<td>5</td>
<td>Elective</td>
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