Module Organisation

<table>
<thead>
<tr>
<th>Start Week</th>
<th>End Week</th>
<th>Lectures per week</th>
<th>Lectures total</th>
<th>Tutorials per week</th>
<th>Tutorials total</th>
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<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>3</td>
<td>33</td>
<td>1</td>
<td>11</td>
</tr>
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Module Description

The objective of the Technology section of this module is to develop in students the capability to understand, analyse, design, and/or select the tooling, forming machinery and processes necessary for the production of metallic and polymer components. The focus will be on enabling students to understand the underlying material science and mathematical theories that underpin the production of components with particular emphasis on: – the identification of product defects; the design of forming tooling and the selection of forming equipment; the optimum and efficient use of materials and energy and the selection of appropriate manufacturing processes with particular emphasis on safety, both personal and environmental.

Learning Outcomes

On successful completion of this module, the student will be able to:

a) Identify the main material properties required and the tooling and the forming process parameters influencing the manufacture of defect free components made of strain-rate sensitive and non-strain-rate materials.

b) Use appropriate yield criteria, material properties and realistic friction and boundary conditions to derive suitable mathematical expression for the evaluation of workpiece and tool stresses and the forming loads to ensure the manufacture of safe, defect free components under safe working conditions and in an environmental friendly manner.

c) Design forming sequences that optimise production rates yet minimises the use/waste of expensive or scarce materials, and the energy required to manufacture a component.

d) Use the material covered in this module in conjunction with a laboratory exercise (Extrusion or Forging) to obtain appropriate data, analyse and discuss that data, and present it in a professional engineering report.

e) Critically assess the suitability of using EDM and ECM for the production of complex geometries in difficult to machine materials, to understand the safety and environmental issues associated with such processes and the
particular factors that affect the quality and safety of the finished component.

f) Calculate the appropriate process parameters associated with polymer extrusion processes including, blow moulding and wire coating.

g) Understand the grading systems for grinding wheels, and select the correct wheel for a given application and predict the final product quality.

h) Analyse grinding processes using equivalent chip thickness, and optimize the process for product quality and costs.

i) Understand the importance of metrology in an engineering and manufacturing framework, and apply concepts to deal with measurement uncertainty and manufacturing errors. Familiarisation with different techniques and instruments to measure form of mechanical parts and their surface texture.

Module Content

- Factors affecting the selection of appropriate tooling, equipment and the processes required for the manufacture of metal and polymer components, with particular emphasis on the influence of material properties on tool design and press selection and product quality.

- Derivation of the underlying mathematical expressions associated with an analysis of the bulk and sheet metal forming processes, including Extrusion, Forging, and the Deep Drawing of sheet components.

- The operating principals and main applications of thermo-electrical processes such as Electro Discharge Machining (EDM) Electro-Chemical Machining (ECM) for the machining high strength materials and the production of complex geometries.

- An analysis of the mechanics of polymer processing with an emphasis on extrusion, sheet forming and injection molding.

- Mechanics, technology and optimisation of grinding processes.

- Principles of welding and industrial techniques.

- Metrology and measurement of surface texture. The accuracy and applications of different methods.

Teaching Strategies
This module is taught using a combination of lectures, structures tutorial sessions. During the tutorial sessions the students work alone to develop their capability for
independent thought, which should contribute to lifelong learning, while the group work will build up their ability to cooperate and work as a member of a team. The tutorial sessions are overseen by a Teaching Assistant.

**Assessment Modes**
Written Exam (85%), and lab report (15%).

**Recommended Texts**
*Principles of Industrial Metalworking Processes*, Rowe.
*Manufacturing Engineering and Technology*, Kalpakjian & Schmid.

**Laboratory**
Extrusion.