Module Title: 3B7 Manufacturing Technology
Code: ME3B7
Level: Junior Sophister
Credits: 5

Lecturer(s): Professor John Monaghan (jmonghan@tcd.ie)
Assistant Prof. Robin Mooney (mooneyrp@tcd.ie)

Module Organisation
The module runs for 12 weeks of the academic year and comprises three lectures per week. A tutorial is given every week. Total contact time is 44 hours.

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<th>Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Lectures per week</th>
<th>Lectures total</th>
<th>Tutorials per week</th>
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<td>1</td>
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<td>12</td>
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Total Contact Hours: 44

Module Description
This module introduces the basic concepts of manufacturing via shaping, forming, machining and assembly, enabling the students to develop a basic knowledge of the mechanics, operation and limitations of basic machining tools and machining processes.

Additionally the module has the following aims and objectives:

- To develop a knowledge of appropriate parameters to be used for various machining operations;
- To introduce the relationship between design and manufacture, with regard to surface finish, process limitations and CNC machining;
- To introduce ancillary technologies such as manufacture of cutting tools, use of cutting fluids, and surface treatment and coating;
- To develop a knowledge of workshop practice and basic use of machine tools and workshop equipment;
- To introduce students to the scientific principles underlying material behaviour during forming processes to enable them to undertake calculations of workpiece and tool stresses and forming loads;
- To introduce students to traditional and non-traditional forming processes with particular emphasis on forging, extrusion, wire drawing, sheet forming, casting, joining and basic polymer processing;
- To introduce students to the role of manufacturing in an economy and to show the relationship between design and manufacturing;

- To make students aware of the necessity to manage manufacturing processes and systems to achieve high quality products free of defects, couples with the necessity to achieve this with the best use of material and human resources and with particular emphasis on the safety of workers, product users and environmental considerations related to manufacture, recycling, etc.
**Learning Outcomes**

On successful completion of this module, students will (be able to):

1. Analyse various machining processes and calculate relevant quantities such as velocities, forces, powers etc;
2. Identify and explain the function of the basic components of a machine tool;
3. Suggest appropriate process parameters and tool materials for a range of different operations and workpiece materials;
4. Have a basic knowledge of safe workshop practice and the environmental implications of machining process decisions;
5. Understand the basic mechanics of the chip formation process and how these are related to surface finish and process parameters;
6. Recognise cutting tool wear and identify possible causes and solutions;
7. Be familiar with common surface treatment and coating processes and aware of their strengths, limitations and environmental impact;
8. Understand the limitations of various machining processes with regard to shape formation and surface quality and the impact this has on design;
9. Develop simple CNC code, and use it to produce components while working in groups. Write a short report based on their work;
10. Explain the relationship between manufacturing technology and systems, the impact of manufacturing on the economy and the relationship between materials selection, design and manufacture;
11. Describe the process involved in taking a product from concept through material selection and design to manufacture and delivery to the customer with particular emphasis to the use of safe design, efficient use of materials, product safety and environmental considerations;
12. Describe and explain applications and perform calculations of the more common bulk and sheet forming, casting, welding and polymer processes and given a particular component select the most appropriate manufacturing process to achieve optimum productivity, product quality through the efficient use of materials, energy and people;
13. Describe, explain and perform calculations on the stress systems associated with the deformation of metals during bulk and sheet forming and perform calculations to determine the forming loads and the loads on both the forming tools and the workpiece.

**Module Syllabus**

- Shape formation in manufacturing;
- Introduction to Turning, Milling and drilling. Basic machine tool structure and terminology, work-holding and tool-setting, and quantitative analysis of machining processes;
- Introduction to CNC machining;
- Fundamentals of Machining. Analysis of chip formation process, cutting mechanics, tool life and machinability;
- Cutting-tool materials and cutting fluids;
- Surface treatment and coating;
- Introduction to manufacturing processes and systems. The relationship between material selection, product design, manufacturing decisions, product uses and safety and environmental considerations;
- Introduction to stress, strain, yielding and plastic flow, complex stress systems, principle stresses and yield criterion (von.mises and Tresca criterion), plane
stress and plane strain conditions, homogeneous deformation and work formulae as used in metal forming calculations;

- Crystal structure of metals, dendrite formation, recrystallisation, the advantages and disadvantages associated with hot and cold working;
- Introduction to the technology associated with forging; rolling; extrusion; wiredrawing; piercing and blanking; bending, casting; joining processes and basic polymer processing;
- Calculations of forming forces and tool/workpiece stresses for each of the forming processes listed above.

**Teaching Strategies**

This module is taught using a combination of lectures and 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 is used to 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**

This module is assessed by a two-hour written examination a laboratory experiment and a metalforming assignment. Examination questions are designed to test the student’s ability to use the knowledge gained in lectures to solve practical problems, bringing together different aspects of the module and of other modules, such as design.

**Recommended Texts**


**Other Relevant Texts**


**Laboratories & Assignment**

- CNC Machining
- Metalforming Assignment