2E8 MATERIALS [5 credits]

Lecturer(s):  Professor David Taylor (dtaylor@tcd.ie): Module Coordinator
Professor Roger West (rwest@tcd.ie)
Associate Prof. Martin Burke (mburke@tcd.ie)
Mr Peter Flynn (peflynn@tcd.ie)

Module organisation
The module runs for the second half of the academic year and comprises of three lectures and one tutorial per week together with two two-hour laboratories.

Module description, aims and contribution to programme
The aims and objectives of this module are:
1. to demonstrate the basic principles of the engineering properties of materials;
2. to appreciate the characteristics of different engineering materials in popular use;
3. to demonstrate the impact of materials selection on design;
4. to appreciate the consequences of materials selection on the environment.

Learning outcomes
Upon completion of this module, students will be able to:
1. Describe the fundamentals of material behaviour.
2. List the major types of materials and explain how their properties can be determined and exploited.
3. Evaluate the environmental implications of materials selection.
4. Carry out individual and group investigations and derive reports of the technical and experimental aspects of a material’s use.

Module content
Engineering Properties of Materials
- Mechanical properties including strength, stiffness, ductility/brittleness, toughness, shrinkage, diffusion and corrosion
- Crystalline and amorphous materials, bonding, slip planes, fracture mechanics, creep and fatigue
- Electrical conductivity and resistivity, emissivity, thermal, magnetic and optical properties, thermal conductivity

Material Selection in Design based on Properties
- Concrete, reinforcing steel, reinforced and pre-stressed concrete, fibre-reinforced concrete composites
- Timber, aluminium and glass as structural materials
- Polymers and ceramics in
- Steel phase diagrams
- Gold, platinum and iridium in brain electrodes
- Materials for electronic devices, shaping device characteristics
**Case Studies**
- Reinforced concrete beams, columns and slabs
- Biomaterials in orthopaedic medical devices
- Flash memories

**Teaching strategies**
The module is taught using a combination of lectures, tutorials, laboratories and a site visit, with a particular focus on independent learning. Most lecturing notes will be made available on the web in advance of lecture delivery. Students work in tutorial and laboratory groups thereby encouraging teamwork and cooperation, whereas the laboratory and site visit reports are individual.

**Associated laboratory/site visit programme**
- Lab 2E8A: Concrete mixes and fresh and hardened properties; timber strength properties
- Lab 2E8B: Steel and aluminium strength and ductility properties

**Assessment**
Assessment is by means of continuous assessment (two laboratory experiments and tutorials (10%) and a two-hour end-of-year written examination (90%).

**Recommended textbook**
- *Engineering Materials*, Ashby and Jones
- *The New Science of Strong Materials: Or Why You Don’t Fall Through the Floor*, J.E. Gordon
- *Introduction to Engineering Materials*, VB John
- *Concrete Practice*, BCA, provided free-of-charge by Irish Cement Ltd
- *Silicon Earth*, John D. Cressler, Cambridge University Press, 2009

**Further information**
http://www.tcd.ie/Engineering/undergraduate/baiyear2/2E8