Module Title: 3A8 Geology for Engineers

Code: CE3A8

Level: Junior Sophister

Credits: 5

Lecturer(s): Dr Quentin Crowley (crowleyq@tcd.ie)
Associate Prof. Bruce Misstear (bmisster@tcd.ie)

Module Organisation
This module consists of 33 lectures over 11 weeks, together with 4 practical exercises and a fieldtrip to a local site of geological interest. All practicals, the field trip and 9 weeks of lectures (geology) are given by Quentin Crowley, the remaining lectures (hydrogeology) are given by Bruce Misstear.

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<th>Engineering Semester or Term</th>
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<th>Hours of Associated Practical Sessions</th>
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Total Contact Hours: 33

Module Description
Geology for Engineers provides an introduction to several areas of Earth Sciences that impact the engineer, including geological materials, earth surface processes, hydrocarbon exploration and production, natural disasters and climate change. Engineers often need to work with geologists. This module will enable the student to operate effectively in such a team by explaining terminology and concepts in the fields stated above. The module also provides the engineer with a natural, regional-scale context in which to place site-specific questions. Financial and time pressures on the engineer necessarily force him/her to concentrate on the site-specific aspects of geology, such as the mechanical properties of the ground and the local risk of natural hazards like flooding, subsidence or earthquakes. This module provides examples of how such local-scale phenomena can be better predicted using knowledge of regional-scale geological processes. The student will learn the kind of questions that geologists can answer, allowing him/her to better assess how much time/money to spend on geological investigations for any given project.

Learning Outcomes
On completion of this module the student will be able to:
1. Recognise standard terminology, including basic classification systems for geological materials, and terminology applied to important plate tectonic, surface and climatic processes;
2. Describe the formation and internal structure of planet Earth and describe plate tectonic theory;
3. Explain how natural hazards such as earthquakes, tsunamis and volcanoes relate to plate tectonic processes, and explain difficulties in predicting natural disasters;
4. Explain the generation of hydrocarbons within sedimentary basins, use simple exploration techniques, and compare technologies for hydrocarbon exploration and extraction;
5. Describe the roles of glacial, fluvial, hill slope, coastal and submarine processes in forming the natural environment, and appraise whether engineering solutions are appropriate in managing surface processes;
6. Explain the major controls on global climate, describe evidence for natural climate change in the geological record, and assess the engineer’s role in managing anthropogenic climate change;
7. Define basic terms in hydrogeology and apply equations of groundwater flow to simple engineering situations.

Module Content

- Planet Earth [Dr Quentin Crowley]
  - Earth’s internal structure: core, mantle, crust;
  - Plate tectonics – Deformation of the plates: faulting and folding;
  - Earthquake seismology;
  - Describing and classifying rocks and minerals;
  - Measuring geological time.

- Volcanic Processes [Dr Quentin Crowley]
  - Controls on physical properties of magma;
  - Principles of multi-phase geophysical flows;
  - Eruption dynamics;
  - Important mineral deposits produced by volcanic processes.

- Sedimentary basins and Hydrocarbons [Dr Quentin Crowley]
  - Imaging sedimentary basins using reflection seismology;
  - Types of sedimentary basin;
  - Generation of hydrocarbons within sedimentary basins
  - Hydrocarbon exploration techniques.

- Geology of Ireland [Dr Quentin Crowley]
  - Tectonic overview;
  - Basement structure;
  - Examples of igneous rock;
  - Main occurrences of metamorphic rock;
  - Clastic and carbonate sediments.

- Earth surface processes [Dr Quentin Crowley]
  - Glacial landforms and sediments;
  - Weathering, slope and river processes;
Coastal processes;
Role of society in controlling surface processes.

- Natural hazards [Dr Quentin Crowley]
  - Earthquakes;
  - Tsunamis;
  - Volcanic hazards.

- Climate [Dr Quentin Crowley]
  - Role of atmosphere, oceans and the solid Earth in controlling climate;
  - The Greenhouse Effect;
  - Milankovitch cycles;
  - Gas hydrates and CO2 sequestration;
  - Geological history of climate change;
  - Role of society in moderating climate change.

- Hydrogeology [Prof Bruce Misstear]
  - Hydrogeological terms;
  - Occurrence of groundwater;
  - Groundwater head and groundwater flow;
  - Application of hydrogeology to landfill site selection and design;
  - Groundwater protection.

**Assessment**
Assessment is by a two-hour examination at the end of the second semester. All of the material taught in this module (including practicals and field trips) is examinable.

**Recommended Texts**
This module focuses on areas of earth sciences of interest to the engineer. The module website contains illustrated sets of notes that relate directly to each group of geology lectures. These notes are designed to explain the important geological and geophysical processes in language understandable by physical scientists. The notes contain references to specific sections of a number of textbooks and websites in order to encourage students to further improve their knowledge. Recommended texts include:

*Understanding Earth* (second edition), Press & Siever
*The Solid Earth* (second edition), Fowler
*Introducing Groundwater* (second edition), Price
*Water wells and boreholes*, Misstear, Banks & Clark

**Further Information**
Module website, including geology handout notes, practical exercises and past examination papers: [http://www.tcd.ie/Geology/MAIN-PAGE/ce3a8.php](http://www.tcd.ie/Geology/MAIN-PAGE/ce3a8.php)