**4A3 (1) - Environmental Engineering 1 (5 ECTS)**

**Lecturers** Associate Prof. Laurence Gill and Assistant Prof. Aonghus Mc Nabola

**Module Organisation**
This module runs throughout the first semester of the academic year and comprises three lectures per week. In addition there is a two hour laboratory / tutorial periods every week for the module. Two laboratory practicals are to be completed and handed in for marking during the term and one group project. The practicals must be submitted by the last day of the first term. The group project must be submitted by the Friday of the first week of the second semester. The practicals and group project are corrected and handed back to the students. This coursework is discussed during the tutorial periods.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Lectures</th>
<th>Tutorials</th>
<th>Practicals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Per Week</td>
<td>Total</td>
<td>Per Week</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>12</td>
<td>3</td>
<td>27</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Module Description, Aims and Contribution to Programme**
This module aims to develop the basic concepts of Environmental Engineering encountered by the students in the Senior Freshman year by the application of such principles in terms of the analysis of the pollution of the natural aquatic environment, engineering of wastewater treatment and water treatment processes and then the study of air pollution. Analysis of environmental concepts in engineering includes the design of physical, chemical and biological treatment processes, the degradation of pollutants in the natural environment and the atmospheric dispersion of anthropogenic air pollutants.

**Learning Outcomes**
On successful completion of the module, students will be able to:

1. Categorise the difference in quality of water from different sources (such as groundwater and surface water).
2. Interpret a variety of different water quality parameters (physical, chemical and microbiological) with respect to likely waste source and pollution potential.
3. Analyse the degradation of biodegradable organic matter introduced into a watercourse with respect to time.
4. Calculate the dissolved oxygen sag in a water course downstream of an input of organic pollution.
5. Estimate the effect of increased phosphorous loading onto a water body with respect to eutrophic state.
6. Apply chemical engineering process design concepts to the design of a series of reactors for the treatment of both potable water and waste water.
7. Calculate the size of unit processes for the treatment of potable water and waste water on the basis of physical, chemical or biological environmental engineering concepts. In addition be able to calculate the energy / chemical requirements and resultant byproducts from such processes.
8. Demonstrate an awareness of the overall context of water and wastewater treatment with respect to national and international legislation and also human and environmental health.
9. Plan and prepare an overall design of a wastewater treatment plant from basic flow and load data.
10. Recognise a variety of atmospheric pollutants and their sources and analyse their dispersion from point sources under different meteorological conditions.

**Content of Module**
- **Water Quality Fundamentals**
  - Physical / Chemical / Biological characteristics
- **Natural Processes**
  - Dilution / Sedimentation
  - Mass transfer / Heat transfer
  - Stratification / Eutrophication
  - Gas transfer (aeration) / Dissolved Oxygen model
- **Process Design Concepts**
  - Reactor analyses / Mass balance
  - Kinetics of biological growth
Hydraulic profiles

- **Wastewater Treatment**
  - Legislation & quality parameters
  - Wastewater network overview
  - Wastewater characteristics
  - Preliminary / Primary / Secondary / Tertiary treatment
  - Sludge treatment

- **Water Treatment**
  - Legislation & quality parameters
  - Water sources & characteristics
  - Coagulation / Flocculation
  - Filtration / Adsorption
  - Disinfection
  - Oxidation / catalytic ppt / ion exchange / membranes
  - Sludge treatment

- **Air Quality**
  - Atmospheric pollutants and sources
  - Meteorology
  - Atmospheric stability and turbulence
  - Atmospheric dispersion – Gaussian model

**Recommended Texts**

- *Fundamentals of Environmental Engineering* – Mihelcic (Wiley)
- *Wastewater Engineering* – Metcalf and Eddy (McGraw-Hill)
- *Water Supply* – Twort et al. (IWA)
- *Environmental Engineering* – Kiely (McGraw-Hill)

**Teaching Strategies**

This module is taught by a combination of lectures, laboratory classes and tutorials during which a Group Design Project of a wastewater treatment plant is carried out. Extensive handouts for the module are given at the beginning of each lecture. The Group Design Project is handed out to the students in week 6 of the module and aims to encourage problem based learning and teamwork. The completed design has to be submitted by the end of the first week of the second semester. The projects are marked and returned to the students with extensive comments. Two laboratory experiments are also undertaken, one examining the aeration of water and the other demonstrating the coagulation and flocculation of water in order to remove colloidal particles. As assignment on air pollution also forms part of the continuous assessment of this module. These are directly related to material covered in the module and enable the student to experience the practical application of the theoretical analysis of the lectures. Both practicals have to be written up and handed in by the end of the first semester.

**Assessment**

Assessment is performed by examination and performance in this count for 75% of the final mark together with a further 12.5% contribution from the group design project and a 10% contribution from the laboratory practicals and 2.5% air pollution assignment. The examination is two hours long and students are expected to answer three questions.

Definitive and up-to-date module and assessment details for all modules in the School of Engineering is maintained on the School of Engineering website - http://www.tcd.ie/Engineering/ - and this acts as the definitive, relevant and applicable source for all module assessment details for any academic year for any School module.

**Further Information**

http://www.tcd.ie/ Civil_engineering /Courses/BAI
http://www.tcd.ie/Civil_engineering/Staff/Laurence.Gill