Module Code	CE7E05
Module Name	E5: Water Quality & Hydrological Modelling
ECTS Weighting[1]	5 ECTS
Semester taught	Semester 2
Module Coordinator/s	Prof. Laurence Gill (Laurence.gill@tcd.ie) Asst. Prof. Liwen Xiao (liwen.xiao@tcd.ie) Asst. Prof. David O'Connell (david.oconnell@tcd.ie)
Module Learning Outcomes with reference to the Graduate Attributes and how they are developed in discipline	On successful completion of this module, students should be able to: LO1. Develop conceptual models for typical problems within the field of environmental engineering. LO2. Demonstrate an awareness of different approaches to hydro(geo)logical modelling. LO3. Calculate the dissolved oxygen sag in a water course downstream of an input of organic pollution. LO4. Develop complex water quality models for natural processes such as eutrophication and nitrification. LO5. Develop kinetic microbiological models for wastewater treatment processes. LO6. Elucidate the different conceptual flow paths through karst systems. LO7. Construct a numerical model of a lowland karst system using conceptual pipes and tanks. LO8. Interpret soil water potential curves for different soil types. LO9. Develop numerical equations for both steady water flow and transient Flow through saturated & unsaturated soils. **Graduate Attributes: levels of attainment** To act responsibly - Enhanced To think independently - Attained To develop continuously - Attained To communicate effectively - Enhanced

Module Content	This module aims to develop the students' comprehension of the relevance and usefulness of mathematical modelling in both water quality and hydrological scenarios. This will enable students to be able to devise a conceptual model to solve typical problems within the field of environmental engineering. • **Modeling approaches in hydrology** Physical, mathematical and analogue modelling Aquifer testing Groundwater flow modeling Surface hydrological modeling • **Water quality modelling** Fundamental relationships Numerical methods Streeter-Phelps Dissolved Oxygen Model Eutrophication model Nitrification model Activated Sludge Model • **Karst hydrology** Karst generation / landforms Karst hydrogeology Modelling karst conduit networks • **Modelling the vadose zone** Overview & fundamentals of soil science Soil water potential & retention curves Steady water flow in saturated & unsaturated soils Unsteady water flow in saturated & unsaturated soils Solute transport Evaporation and transpiration
Teaching and Learning Methods	This module is taught by a combination of lectures and tutorials during which two assignments are discussed. Copies of the lecture presentations are given to the students just before the beginning of each lecture. The first continuous assessment, on modelling nitrogen transport through the unsaturated zone, is handed out to the students in week 4 of the module. The second continuous assessment, on modelling a constructed wetland treatment process, is handed out to the students in week 7 of the module. Both completed assignments have to be submitted by the last day of the second semester. The projects are marked and returned to the students with constructive comments.

<table>
<tr><td>Assessment Details[2]
Please include the following:
• Assessment Component
• Assessment description
• Learning Outcome(s) addressed
• % of total
• Assessment due date</td><td>
<table>
<tr><td>Assessment Component</td><td>Assessment Description</td><td>LO Addressed</td><td>% of total</td><td>Week due</td></tr>
<tr><td>Continuous assessment 1</td><td>Modelling Assignment (unsaturated flow)</td><td>LO4, LO8, LO9</td><td>15%</td><td>9</td></tr>
<tr><td>Continuous assessment 2</td><td>Modelling Assignment (constructed wetland)</td><td>LO1, LO5</td><td>15%</td><td>12</td></tr>
<tr><td>Examination</td><td>Examination [3 hours]</td><td>LO1 – LO9</td><td>70%</td><td>-</td></tr>
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<tr><td>Reassessment Requirements</td><td>Examination [3 hours]</td></tr>
<tr><td>Contact Hours and Indicative Student Workload[2]</td><td>
<table>
<tr><td>Contact hours: 27</td></tr>
<tr><td>Independent Study (preparation for course and review of materials): 40.5</td></tr>
<tr><td>Independent Study (preparation for assessment, incl. completion of assessment): 32.5</td></tr>
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<tr><td>Recommended Reading List</td><td>Water quality modelling – Steven Chapra [McGraw-Hill]
Soil Physics with Hydrus – Radcliffe & Simunek [CRC Press]
Introduction to Soil Physics – Hillell [Elsevier]
Rainfall-runoff modelling – The Primer – Beven [Wiley]</td></tr>
<tr><td>Module Pre-requisite</td><td>n/a</td></tr>
<tr><td>Module Co-requisite</td><td>n/a</td></tr>
<tr><td>Module Website</td><td>http://www.tcd.ie/Engineering/undergraduate/maiyear5/</td></tr>
<tr><td>Are other Schools/Departments involved in the delivery of this module? If yes, please provide details.</td><td>NO</td></tr>
<tr><td>Module Approval Date</td><td></td></tr>
<tr><td>Approved by</td><td></td></tr>
<tr><td>Academic Start Year</td><td>1st September 2020</td></tr>
<tr><td>Academic Year of Date</td><td>2020/2021</td></tr>
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