**Module Template for New and Revised Modules**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>CEU33A03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module Name</td>
<td>3A3 HYDRAULICS</td>
</tr>
<tr>
<td>ECTS Weighting</td>
<td>5 ECTS</td>
</tr>
<tr>
<td>Semester taught</td>
<td>Semester 2</td>
</tr>
<tr>
<td>Module Coordinator/s</td>
<td>Aonghus McNabola</td>
</tr>
</tbody>
</table>

**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. Estimate the flows in pipes and channels from devices such as notches, weirs and flumes.
- LO2. To develop the head/discharge relationship for pipes, allowing for friction in the pipes and loss of head at bends etc.
- LO3. To predict the depth variation in open channels
- LO4. To analyse the flows and head in pipe networks and to assess the effect of including pumps within these systems.
- LO5. To design water distribution networks, appraise differing design approaches and communicate design approaches.
- LO6. To estimate the flow in gravity sewer systems and determine hydraulic loads from both wastewater and storm water under different design storm conditions, including for climate change.
- LO7. To design the size and assess the efficiency of a Combined Sewer Overflow at different settings.

**Graduate Attributes: levels of attainment**

- To act responsibly - Introduced
- To think independently - Enhanced
- To develop continuously - Attained
- To communicate effectively - Enhanced

**Module Content**

Hydraulics is a one semester module which provides students with the concepts of hydraulic engineering. The module reviews the relevant aspects of fluid flow developed in 2E5, such as Bernoulli’s equation, and the momentum and continuity relationships and demonstrates how these are developed for use in Civil Engineering design. The module develops the concept of analysing time varying problems using quasi-steady state relationship and compares the results with some readily developed closed form solutions. The methods

---

1. [An Introduction to Module Design](#) from AISHE provides a great deal of information on designing and re-designing modules.
2. [TEP Glossary](#)
of developing head/discharge relationships for pipe flows which includes for friction loss are formulated. The principals involved in the flow of water in open channels are explained and relationships are developed to allow the estimation of the discharge in open channels and the depth variation behind control structures. The methods used to analyse pipe networks, with and without pumps within the system, are developed. The design of water distribution systems providing an adequate supply of water to consumers is also examined. Finally, the module examines the subject of Urban Drainage, initially comparing combined systems against separate systems. The calculation of hydraulic loads for the network is then demonstrated for both wastewater quantities and also storm water predictions from the analysis of rainfall events. The hydraulic design of the pipe network to these loads is then examined before moving onto the design of Combined Sewer Overflows which are used to relieve the system hydraulically under storm conditions.

- Velocity & Discharge
- The Momentum Equation
- Energy and Flow of water in pipes
- Quasi-Steady Flow
- Open channel flow
- Pipe network analysis
- Pump-Pipe Systems
- Pumps
- Urban Drainage Systems
- Design of Water Distribution Systems

**Teaching and Learning Methods**

- e.g., lectures, seminars, online learning via VLE, field trips, laboratories, practice-based etc...
### Assessment Details

Please include the following:

- **Assessment Component**
- **Assessment description**
- **Learning Outcome(s) addressed**
- **% of total**
- **Assessment due date**

<table>
<thead>
<tr>
<th>Assessment Component</th>
<th>Assessment Description</th>
<th>LO Addressed</th>
<th>% of total</th>
<th>Week due</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examination</td>
<td>2 hour written examination</td>
<td>LO1-4 &amp; 6-7</td>
<td>60%</td>
<td></td>
</tr>
<tr>
<td>Group Project</td>
<td></td>
<td>LO5</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Labs &amp; Assignments</td>
<td></td>
<td>LO1-7</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

### Reassessment Requirements

100% written examination

### Contact Hours and Indicative Student Workload

**Contact hours:** 33 lectures, 3 lab sessions, 2 tutorials

- **Independent Study (preparation for course and review of materials):** 37hrs
- **Independent Study (preparation for assessment, incl. completion of assessment):** 50hrs

### Recommended Reading List


*Hydraulics in civil and environmental engineering*, Chadwick & Morfett (E & FN Spon).

*Urban Drainage*, Butler & Davies (E & FN Spon).

---

3 TEP Guidelines on Workload and Assessment
<table>
<thead>
<tr>
<th>Academic Start Year</th>
<th>January 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Year of Date</td>
<td>2019-20</td>
</tr>
</tbody>
</table>