<table>
<thead>
<tr>
<th><strong>Academic Year</strong></th>
<th>2010-2011</th>
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<tbody>
<tr>
<td><strong>Module Code</strong></td>
<td>CS7030</td>
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<tr>
<td><strong>Module Title</strong></td>
<td>Numerical Methods &amp; Advanced Mathematical Modelling 1</td>
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<tr>
<td><strong>Pre-requisites</strong></td>
<td>BA/BSc/BEng (or equivalent) that includes mathematics and statistics</td>
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<td><strong>ECTS</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>Chief Examiner</strong></td>
<td>Dr. Micheál Mac an Airchinnigh</td>
</tr>
<tr>
<td><strong>Teaching Staff</strong></td>
<td>Dr. Micheál Mac an Airchinnigh</td>
</tr>
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<td><strong>Delivery</strong></td>
<td>2 lectures and 1 tutorial per week; attendance is obligatory</td>
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**Aims**
- Encourage and foster the development of independent critical thinking.
- In particular students should be able to:
  - model problems using mathematics and statistics,
  - formulate and propose solutions,
  - infer from observation and interpret results.
- The students should be able to use, critique, and edit (where relevant) Internet resources such as Wikipedia, Wolfram Research,…

**Learning Outcomes**
- When students have successfully completed this module, they will be able to:
  - model and solve problems using three distinct, yet complementary, approaches: analytical, numerical and observational.
  - construct mathematical programs using computational resources such as Mathematica, MATLAB,…

**Syllabus**
- Specific themes addressed within the module will be drawn from the list:
  - Linear Algebra
    - Vector spaces, linear maps
    - Matrices
  - Analytics
    - Ordinary Differential Equations, Laplace transforms
    - Recurrence Relations and Difference Equations, z-transforms
    - Random Systems 1, random number generators
  - Numerics
    - Ordinary Differential Equations, Finite Difference Methods
    - Cellular Automata 1, basic theory and applications
  - Observations
    - Function Fitting, Least Squares, Levenberg-Marquardt Method.
    - Architectures: Padé Approximants, Splines, Orthogonal functions, Neural Networks
    - Time Series 1, linear time series

**Assessment**
- Project / Assignment – 20%
- Examination – 80%

**Bibliography**
- Main Course Text:  
  Each student will choose those texts from the Trinity College Library that address and expand upon her/his own particular Mathematical interests within the analytical, numerical and observational framework. In addition each student will avail of appropriate scholarly Internet resources such as
<table>
<thead>
<tr>
<th><strong>Website</strong></th>
<th><a href="http://www.scss.tcd.ie/postgraduate/mscict/">http://www.scss.tcd.ie/postgraduate/mscict/</a></th>
</tr>
</thead>
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Wolfram’s “*A New Kind of Science*.”

Students are expected to be able to access papers in the research journals appropriate to their own speciality within the degree program.