Computer Science and Maths wIE BSc (Hons) 2013-2014
Summary

<table>
<thead>
<tr>
<th>UCAS code</th>
<th>Award</th>
<th>Title</th>
<th>Duration</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>GG41</td>
<td>BSc</td>
<td>Computer Science and Maths wIE BSc (Hons)</td>
<td>4 years</td>
<td>FT + Placement year</td>
</tr>
</tbody>
</table>

Schools
- Computer Science
- Mathematics

Faculty
- Engineering and Physical Sciences

Awarding Institution
- University of Manchester

Programme Accreditation
- BCS

Relevant QAA benchmark(s)
- Computing, Mathematics
Aims and intended learning outcomes

The programmes aim to:

1) enable graduates to exhibit a high level of practical and theoretical skills over a broad range of Computer Science together with a knowledge of currently available techniques and technologies.

2) enable students to acquire a knowledge and understanding of mathematical ideas, including the concepts of rigorous argument and formal proof, and an appreciation of the power and generality of abstract formulation and the analytic method.

3) enable students to develop their capacity to learn and apply mathematical ideas and skills.

4) give students the opportunity to have studied a combination of mathematics and computer science and have an appreciation of the subjects themselves and their close relationship.

5) give students sufficient knowledge of mathematics and computer science principles to be able to meet confidently future developments in a rapidly changing area.

6) provide the opportunity for students to study on a programme at the forefront of both computer science and mathematics which is informed by current research and in particular by the research specialisations of the teaching staff.

7) In addition, the with Industrial Experience programme aims to: give extensive practical experience of an industrial or business environment where students are able to apply and develop their skills, both technical and personal.

Intended learning outcomes

Knowledge & understanding

A1 Know and understand the essential mathematics relevant to computer science.

A2 Understand and apply a wide range of principles and tools available to the software engineer, such as design methodologies, choice of algorithm, language, software libraries and user interface techniques

A3 Demonstrate a grasp of the principles of computer systems, including architecture, networks and communication

A4 Recognise and appreciate the professional and ethical responsibilities of the practising computer professional, including understanding the need for quality

A5 Know and understand the principles and techniques of a number of application areas informed by the research directions of the subject, such as artificial intelligence, databases and computer graphics

A6 Apply their knowledge of computing in a commercial or industrial context

A7 Show a critical understanding of the broad context within which Computer Science resides, including issues such as quality, reliability, enterprise, employment law, accounting and health and safety

A8 Have a comprehensive knowledge and critical awareness of selected specialist fields at the forefront of computer science, studied at masters level

Intellectual (thinking) skills

B1 Solve a wide range of problems related to the analysis, design and construction of computer systems.

B2 Design and implement a software or hardware system of significant size

B3 Identify a range of solutions and critically evaluate and justify proposed design solutions

B4 Solve computer science problems with pressing commercial or industrial constraints

B5 Generate an innovative design to solve a problem containing a range of commercial and industrial constraints

Practical skills
C1 Plan and undertake a major individual project
C2 Prepare and deliver coherent and structured verbal and written technical reports
C3 Give technical presentations suitable for the time, place and audience
C4 Use the scientific literature effectively and make discriminating use of Web resources
C5 Design, write and debug computer programs in appropriate languages
C6 Use appropriate computer-based design support tools
C7 Apply computer science skills in a commercial or industrial environment
C8 Demonstrate initiative taking, innovation and self-management in an industrially related group project
C9 Integrate previously acquired skills and apply them to new, demanding situations

Transferable skills
D1 Display an integrated approach to the deployment of communication skills
D2 Use IT skills and display mature computer literacy
D3 Work effectively with and for others
D4 Strike the balance between self-reliance and seeking help when necessary in new situations
D5 Display personal responsibility by working to multiple deadlines in complex activities
D6 Employ discrete and continuous mathematical skills as appropriate
D7 Demonstrate significantly enhanced group working abilities
D8 Further develop career plans and personal objectives
D9 Communicate effectively with non-specialist as well as computer scientist professionals at a range of levels
D10 Undertake a range of technical roles within a team and be able to display leadership
Teaching, learning and assessment methods

Learning and Teaching on all our programmes aims to combine an understanding of fundamental CS principles, development of strong practical skills and the group-working, learning and communication skills that are essential for any computing professional.

Course units which involve practical elements all have associated laboratory exercises, usually in timetabled sessions with staff and demonstrator support. Most labs operate a system of face-to-face marking in the lab so that students receive immediate feedback on their work. Units without labs all have regular coursework exercises to support skills development and feedback.

Most units are lecture based, with lab or coursework exercises used to reinforce and enhance knowledge and skills first encountered in lectures. The first year team project deviates significantly from this model and takes an Enquiry Based Learning approach. This unit aims to encourage students to be more actively engaged with, and responsible for, their own learning, to develop skills in problem solving, communication, independent learning, and group work, and to signal the importance we attach to independent learning. This approach is followed up in the second year with the workshop based approach used in the compulsory Software Engineering unit, which also contains a major group working component.

All students undertake an individual 3rd year project, supervised by a member of academic task, which usually involves the development of significant software or hardware product. Assessment of this unit involves presentations of plans and results and a major written report.

Assessment in almost all units is a combination of lab/coursework and examination.

Learning, Teaching and Assessment of intended learning outcomes

Knowledge and Understanding

<table>
<thead>
<tr>
<th>Learning and Teaching Processes</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures (A1, A2, A3, A4, A5, A6, A7)</td>
<td>Unseen written examinations (A1, A2, A3, A4)</td>
</tr>
<tr>
<td>Laboratory sessions (A2, A3)</td>
<td>Marked tutorial exercises (A1, A2, A3, A4)</td>
</tr>
<tr>
<td>Personal tutorials (A1, A2, A3, A4, A7)</td>
<td>Laboratory reports (A2, A3)</td>
</tr>
<tr>
<td>Problem solving classes (A1, A2, A3, A4)</td>
<td>Project reports (individual and group) (A3, A4, A5,A6, A7)</td>
</tr>
<tr>
<td>Problem-based learning (A2, A3, A4, A5, A6, A7)</td>
<td>Oral presentations (individual and group) (A3, A4, A5, A6, A7)</td>
</tr>
<tr>
<td>Projects (A3, A4, A5, A6, A7)</td>
<td></td>
</tr>
<tr>
<td>Industrial seminars (A4, A5, A6, A7)</td>
<td></td>
</tr>
</tbody>
</table>

Intellectual Skills

<table>
<thead>
<tr>
<th>Learning and Teaching Processes</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures (B1, B2, B4, B5)</td>
<td>Unseen written examinations (B1, B2, B4)</td>
</tr>
<tr>
<td>Laboratory sessions (B1, B2)</td>
<td>Marked tutorial exercises (B1, B2)</td>
</tr>
<tr>
<td>Personal tutorials (B1, B2, B4)</td>
<td>Laboratory reports (B1, B2)</td>
</tr>
<tr>
<td>Problem solving classes (B1, B2, B4)</td>
<td>Project reports (individual and group) (B1, B2, B3,B4, B5)</td>
</tr>
<tr>
<td>Problem-based learning (B1, B2, B4)</td>
<td>Oral presentations (individual and group) (B1, B2, B3, B4, B5)</td>
</tr>
<tr>
<td>Projects (B1, B2, B3, B4, B5)</td>
<td></td>
</tr>
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Practical Skills

<table>
<thead>
<tr>
<th>Learning and Teaching Processes</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures (C4, C6)</td>
<td>Laboratory reports (C1, C2, C3, C4, C5, C6, C7)</td>
</tr>
<tr>
<td>Laboratory sessions (C1, C2, C3, C4, C5, C6, C7)</td>
<td>Project reports (individual and group) (C3, C4, C5,C6)</td>
</tr>
<tr>
<td>Projects (C3, C4, C5, C6,C9)</td>
<td>Oral presentations (individual and group) (C6, C8,C9)</td>
</tr>
<tr>
<td>Industrial placement (C8,C9)</td>
<td>Industrial placement reports (C8,C9)</td>
</tr>
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</table>

Transferable skills

<table>
<thead>
<tr>
<th>Learning and Teaching Processes</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures (D3, D4, D5, D7)</td>
<td>Laboratory reports (D1, D3, D5, D6)</td>
</tr>
<tr>
<td>Laboratory sessions (D1, D3, D5, D6)</td>
<td>Essays (D2, D3)</td>
</tr>
<tr>
<td>--------------------------------------</td>
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<tr>
<td>Personal tutorials (D1, D2, D3, D4, D7)</td>
<td>Project reports (individual and group) (D1, D2, D3, D4, D5, D6, D7)</td>
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<tr>
<td>Problem solving classes (D4)</td>
<td>Oral presentations (individual and group) (D1, D3, D6, D7, D8)</td>
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<tr>
<td>Problem-based learning (D1, D2, D3, D4, D5, D6)</td>
<td>Industrial placement reports (D8)</td>
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<tr>
<td>Projects (D1, D2, D3, D4, D5, D6, D7)</td>
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<tr>
<td>Industrial placement (D8)</td>
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</tbody>
</table>
Programme structure

**MANDATORY UNITS** - 100 CREDITS

**OPTIONAL UNITS** - 10 CREDITS PER OPTION POOL

**OPTION POOL 1** - MINIMUM AND MAXIMUM 10 CREDITS

**OPTION POOL 2** - MINIMUM AND MAXIMUM 10 CREDITS

### Level 1 - compulsory units

All of the units in this pool are mandatory.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP10120</td>
<td>First Year Team Project</td>
<td>20</td>
</tr>
<tr>
<td>COMP16121</td>
<td>Object Oriented Programming with Java 1</td>
<td>20</td>
</tr>
<tr>
<td>COMP16212</td>
<td>Object Oriented Programming with Java 2</td>
<td>10</td>
</tr>
<tr>
<td>MATH10111</td>
<td>Sets, Numbers and Functions</td>
<td>15</td>
</tr>
<tr>
<td>MATH10131</td>
<td>Calculus and Vectors</td>
<td>15</td>
</tr>
<tr>
<td>MATH10212</td>
<td>Linear Algebra</td>
<td>15</td>
</tr>
<tr>
<td>MATH10232</td>
<td>Calculus and Applications</td>
<td>15</td>
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</table>

### Level 1 - option pool 1

From this option pool choose 10 credits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP11212</td>
<td>Fundamentals of Computation</td>
<td>10</td>
</tr>
<tr>
<td>COMP14112</td>
<td>Fundamentals of Artificial Intelligence</td>
<td>10</td>
</tr>
<tr>
<td>COMP18112</td>
<td>Fundamentals of Distributed Systems</td>
<td>10</td>
</tr>
</tbody>
</table>

### Level 2 options

**MANDATORY UNITS** - 60 CREDITS (20 CORE UNITS AND 40 FROM OPTION POOL 1)

**OPTIONAL UNITS** - 60 CREDITS

**OPTION POOL 1** - MINIMUM AND MAXIMUM 40 CREDITS (Note: if you choose COMP23311 you must also take COMP23412.)

**OPTION POOL 2** - MINIMUM AND MAXIMUM 10 CREDITS

**OPTION POOL 3** - MINIMUM AND MAXIMUM 10 CREDITS

**OPTION POOL 4** - MINIMUM AND MAXIMUM 10 CREDITS

**OPTION POOL 5** - MINIMUM AND MAXIMUM 30 CREDITS

If you take a 20 credit whole year course unit you are not permitted to drop this unit when course unit selection reopens at the start of semester 2.

### Level 2 - compulsory units

All of the units in this pool are mandatory.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>COMP23420</td>
<td>Software Engineering</td>
<td>20</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>COMP26120</td>
<td>Algorithms and Imperative Programming</td>
<td>20</td>
<td>Programming and Algorithms</td>
</tr>
<tr>
<td>MATH20111</td>
<td>Real Analysis</td>
<td>10</td>
<td>None</td>
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<tr>
<td>MATH20142</td>
<td>Complex Analysis</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>MATH20201</td>
<td>Algebraic Structures 1</td>
<td>10</td>
<td>None</td>
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</table>

### Level 2 - option pool 1

From this option pool choose 10 credits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP21111</td>
<td>Logic and Modelling</td>
<td>10</td>
<td>Rigorous Development</td>
</tr>
<tr>
<td>COMP23111</td>
<td>Fundamentals of Databases</td>
<td>10</td>
<td>Web and Distributed Systems</td>
</tr>
<tr>
<td>COMP24111</td>
<td>Machine Learning and Optimisation</td>
<td>10</td>
<td>Learning and Search in Artificial Intelligence</td>
</tr>
<tr>
<td>COMP25111</td>
<td>Operating Systems</td>
<td>10</td>
<td>Computer Architecture</td>
</tr>
<tr>
<td>COMP28411</td>
<td>Computer Networks</td>
<td>10</td>
<td>Mobile Computing and Networks</td>
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### Level 2 - option pool 2

From this option pool choose 10 credits.

<table>
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<tr>
<th>Code</th>
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<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>MATH10141</td>
<td>Probability</td>
<td>10</td>
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</table>
Level 2 - option pool 3
From this option pool choose 10 credits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP24412</td>
<td>Symbolic AI</td>
<td>10</td>
<td>Natural Language, Representation and Reasoning</td>
</tr>
<tr>
<td>COMP27112</td>
<td>Computer Graphics and Image Processing</td>
<td>10</td>
<td>Visual Computing</td>
</tr>
<tr>
<td>COMP28112</td>
<td>Distributed Computing</td>
<td>10</td>
<td>Web and Distributed Systems</td>
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</table>

Level 2 - option pool 4
From this option pool choose 20 credits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>MATH20122</td>
<td>Metric Spaces</td>
<td>10</td>
<td>None</td>
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<tr>
<td>MATH20212</td>
<td>Algebraic Structures 2</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>MATH20302</td>
<td>Propositional Logic</td>
<td>10</td>
<td>None</td>
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<tr>
<td>MATH20602</td>
<td>Numerical Analysis 1</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>MATH20902</td>
<td>Discrete Mathematics</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>MATH20912</td>
<td>Introduction to Financial Mathematics</td>
<td>10</td>
<td>None</td>
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</tbody>
</table>

Level 3 options

**MANDATORY UNITS** - 30 CREDITS

**OPTIONAL UNITS** - 90 CREDITS

Out of the remaining 90 credits of free choice:
You must choose at least 50 credits of optional MATH course units from Option Pool 3.
A minimum of 40 credits of MATH units must be at level 3.

**OPTION POOL 1** - MINIMUM 10 AND MAXIMUM 30 CREDITS

**OPTION POOL 2** - MINIMUM 10 AND MAXIMUM 30 CREDITS

**OPTION POOL 3** - MINIMUM 50 AND MAXIMUM 70 CREDITS

A minimum of 20 credits and a maximum of 70 credits for Semester 1
A minimum of 20 credits and a maximum of 40 credits for Semester 2

You must ensure your credits are balanced over the academic year (60 credits in each semester).

If you take a 20 credit whole year course unit you are not permitted to drop this unit when course unit selection reopens at the start of semester 2.

Please note that some combinations of course units may not be possible due to timetable clashes.

If you wish to enrol on optional units (COMP or MATH) that are not listed below you must have permission from the Programme Tutor - Dr Andrea Schalk.

Level 3 - compulsory units
All of the units in this pool are mandatory.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Theme</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP30030</td>
<td>3rd Year Project (Joint Hons 30 Credits)</td>
<td>30</td>
<td>None</td>
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</tbody>
</table>

Level 3 - option pool 1
From this option pool choose a maximum of 40 credits and a minimum of 30 credits.

<table>
<thead>
<tr>
<th>Code</th>
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<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>COMP31111</td>
<td>Verified Development</td>
<td>10</td>
<td>Rigorous Development</td>
</tr>
<tr>
<td>COMP31212</td>
<td>Concurrency and Process Algebra</td>
<td>10</td>
<td>Rigorous Development</td>
</tr>
<tr>
<td>COMP33411</td>
<td>Software Design using Patterns</td>
<td>10</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>COMP33512</td>
<td>User Experience</td>
<td>10</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>COMP33711</td>
<td>Agile Software Engineering</td>
<td>10</td>
<td>Agile Methods</td>
</tr>
<tr>
<td>COMP33812</td>
<td>Software Evolution</td>
<td>10</td>
<td>Agile Methods</td>
</tr>
<tr>
<td>COMP34120</td>
<td>AI and Games</td>
<td>20</td>
<td>Learning and Search in Artificial Intelligence</td>
</tr>
<tr>
<td>COMP34411</td>
<td>Natural Language Systems</td>
<td>10</td>
<td>Natural Language, Representation and Reasoning</td>
</tr>
<tr>
<td>COMP34512</td>
<td>Knowledge Representation and Reasoning</td>
<td>10</td>
<td>Natural Language, Representation and Reasoning</td>
</tr>
<tr>
<td>COMP35112</td>
<td>Chip Multiprocessors</td>
<td>10</td>
<td>Computer Architecture</td>
</tr>
<tr>
<td>COMP36111</td>
<td>Advanced Algorithms I</td>
<td>10</td>
<td>Programming and Algorithms</td>
</tr>
<tr>
<td>COMP36212</td>
<td>Advanced Algorithms II</td>
<td>10</td>
<td>Programming and Algorithms</td>
</tr>
</tbody>
</table>
Level 3 - option pool 2

From this option pool choose a maximum of 70 credits
and a minimum of 40 credits.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credits</th>
<th>Theme</th>
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</thead>
<tbody>
<tr>
<td>COMP39112</td>
<td>Understanding Programming Languages</td>
<td>10</td>
<td>None</td>
</tr>
<tr>
<td>COMP36512</td>
<td>Compilers</td>
<td>10</td>
<td>Computer Languages</td>
</tr>
<tr>
<td>COMP37111</td>
<td>Advanced Computer Graphics</td>
<td>10</td>
<td>Visual Computing</td>
</tr>
<tr>
<td>COMP37212</td>
<td>Computer Vision</td>
<td>10</td>
<td>Visual Computing</td>
</tr>
<tr>
<td>COMP38120</td>
<td>Documents, Services and Data on the Web</td>
<td>20</td>
<td>Web and Distributed Systems</td>
</tr>
<tr>
<td>COMP38411</td>
<td>Cryptography and Network Security</td>
<td>10</td>
<td>Mobile Computing and Networks</td>
</tr>
<tr>
<td>COMP38512</td>
<td>Digital Wireless Communication and Networks</td>
<td>10</td>
<td>Mobile Computing and Networks</td>
</tr>
<tr>
<td>COMP39112</td>
<td>Quantum Computing</td>
<td>10</td>
<td>None</td>
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</tbody>
</table>

School of Computer Science

Page 8
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH10111</td>
<td>Sets, Numbers and Functions</td>
<td>C</td>
</tr>
<tr>
<td>MATH10131</td>
<td>Calculus and Vectors</td>
<td>C</td>
</tr>
<tr>
<td>MATH10141</td>
<td>Linear Algebra</td>
<td>C</td>
</tr>
<tr>
<td>MATH10220</td>
<td>Calculus and Applications</td>
<td>C</td>
</tr>
<tr>
<td>MATH10113</td>
<td>Real Analysis</td>
<td>O</td>
</tr>
<tr>
<td>MATH10122</td>
<td>Metric Spaces</td>
<td>O</td>
</tr>
<tr>
<td>MATH10151</td>
<td>Complex Analysis</td>
<td>C</td>
</tr>
<tr>
<td>MATH10240</td>
<td>Algebraic Structures 1</td>
<td>C</td>
</tr>
<tr>
<td>MATH10112</td>
<td>Algebraic Structures 2</td>
<td>C</td>
</tr>
<tr>
<td>MATH10401</td>
<td>Partial Differential Equations and Vector Calculus</td>
<td>O</td>
</tr>
<tr>
<td>MATH10320</td>
<td>Numerical Analysis 1</td>
<td>O</td>
</tr>
<tr>
<td>MATH10161</td>
<td>Elective Mathematics</td>
<td>O</td>
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<tr>
<td>MATH10162</td>
<td>Introduction to Financial Mathematics</td>
<td>O</td>
</tr>
<tr>
<td>MATH10171</td>
<td>Linear Analysis</td>
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<tr>
<td>MATH10111</td>
<td>Fourier Analysis (Real Analysis) and Lebesgue Integration</td>
<td>O</td>
</tr>
<tr>
<td>MATH10242</td>
<td>Analytic Number Theory</td>
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</tr>
<tr>
<td>MATH10131</td>
<td>Introduction to Topology</td>
<td>O</td>
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<td>MATH10122</td>
<td>Algebraic Topology</td>
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</tr>
<tr>
<td>MATH10200</td>
<td>Group Theory</td>
<td>O</td>
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<tr>
<td>MATH10242</td>
<td>Commutative Algebra</td>
<td>O</td>
</tr>
<tr>
<td>MATH10151</td>
<td>Coding Theory</td>
<td>O</td>
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<td>MATH10152</td>
<td>Hyperbolic Geometry</td>
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<td>MATH10162</td>
<td>Introduction to Algebraic Geometry</td>
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<td>MATH10280</td>
<td>Projective Plane</td>
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<tr>
<td>MATH10400</td>
<td>Applied Complex Analysis</td>
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<td>MATH10411</td>
<td>Asymptotic Expansions and Perturbation Methods</td>
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<td>MATH10400</td>
<td>Matrix Analysis</td>
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<td>MATH10412</td>
<td>Problem Solving by Computer</td>
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<tr>
<td>MATH10400</td>
<td>Computational Graph Theory</td>
<td>O</td>
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<tr>
<td>MATH10400</td>
<td>Mathematical Programming</td>
<td>O</td>
</tr>
<tr>
<td>MATH10400</td>
<td>Mathematical Modelling in Finance</td>
<td>O</td>
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Mechanisms for programme revision

Course units are reviewed annually by the Undergraduate Committee, as part of the Annual Review process, taking into account the results and comments from Course Unit Evaluation Questionnaires. Input is also received from the Teaching Assessment Panel, which has a responsibility for monitoring teaching quality in the School.

Programmes have been reviewed regularly by groups created specifically for this purpose; the last major review resulted in a new programme portfolio design which started in the first year in 2008-9. The responsibility for leadership of programme review is now in the hands of the Director of Teaching Strategy (currently Dr Steve Pettifer) who chairs a School Teaching Strategy Committee.