University of Plymouth

Faculty of Science and Engineering

School of Computing Electronics and Mathematics

Programme Specification

BSc (Hons) Mathematics with High Performance Computing (5301)

September 2017

1. BSc (Hons) Mathematics with High Performance Computing

Final award title **BSc (Hons) Mathematics with High Performance Computing**

Level 4 Intermediate award title(s) **Certificate of Higher Education**

Level 5 Intermediate award title(s) **Diploma of Higher Education**

UCAS code G1I1
JACS code G100, I115

2. Awarding Institution: University of Plymouth

Teaching institution(s): University of Plymouth

3. Accrediting body(ies)
The Institute of Mathematics and its Applications (IMA)

Summary of specific conditions/regulations
None

4. Distinctive Features of the Programme and the Student Experience

Generic to our mathematics degrees

- Contemporary, research-informed syllabus with a focus on applications, problem solving and employability. Staged approach to teaching mathematics: **foundation – consolidation – application**. The latter aimed at real-life context.
- Programme provides a unique student experience: engaged teaching using up-to-date methodology and technology plus holistic approach to student support (open-door policy and elaborate tutor system offering pastoral support, career and skills development).
- Employability: general problem solving, ICT and communication skills

Specific to this degree

- Development of broad analytic and reasoning skills based on mathematical logic and parallel computing paradigms and an awareness of limitations and pitfalls of mathematical modelling and parallel computation.
- Range of mathematics and high performance computing options at final stage to accommodate students' interests and career aspirations.

5. Relevant QAA Subject Benchmark Group(s)

Mathematics, Statistics and Operational Research (MSOR)

6. Programme Structure

This programme builds computing knowledge through each stage. In Stage 1, MATH1608 builds experience with the world of big data and MATH1606 gives experience in basic programming skills. In Stage 2, MATH2603 discusses numerical solutions of differential equations and MATH2607 gives the necessary background in Programming and HPC applications, whilst the Monte-Carlo applications in MATH2605 give one important paradigm in HPC computation. In the final stage, MATH3625 / MATH3628 allow students to develop their own HPC code. MATH3605 builds further applications of computing to partial differential equations.

Stage 1. HE Level 4. All modules are 20-credit

MATH1601 Mathematical Reasoning		
MATH1602 Calculus and Analysis	**MATH1603** Linear Algebra and Complex Numbers	Semester 1
MATH1608PP Understanding Big Data from Social Networks.		
MATH1605 Probability with Applications	**MATH1606** Numerical and Computational Methods	Semester 2

Stage 2. HE Level 5. All modules are 20-credit

MATH2601 Advanced Calculus	**MATH2602** Statistical Inference and Regression	**MATH2607** Mathematical Computing	Semester 1
MATH2604 Mathematical Methods and Applications	**MATH2605** Operational Research and Monte Carlo Methods	**MATH2603** Ordinary Differential Equations	Semester 2

Stage 4. HE Level 6. All modules are 20-credit

MATH3613 Data Modelling	**MATH3605** Partial Differential Equations	**Option**	Semester 1
MATH3625 High Performance Computing in context*	**MATH3609** Optimisation, Networks and Graphs	**Option**	Semester 2

***** Could be replaced by MATH3616 **or** MATH3628

Stage 1 Core Modules

Module Code	Module Title	Credit	Semester
MATH1601	Mathematical Reasoning	20	S1
MATH1602	Calculus and Analysis	20	S1
MATH1603	Linear Algebra and Complex Numbers	20	S1
MATH1605	Probability with Applications	20	S2
MATH1606	Numerical and Computational Methods	20	S2
MATH1608PP*	Understanding Big Data from Social Networks	20	S2
BPIE113	Stage1 Mathematics Placement Preparation	0	AY

*Could be replaced by MATH1604PP Symmetry and Space

Stage 2 Core Modules

Module Code	Module Title	Credit	Semester
MATH2601	Advanced Calculus	20	S1
MATH2602	Statistical Inference and Regression	20	S1
MATH2603	Ordinary Differential Equations	20	S2
MATH2604	Mathematical Methods and Applications	20	S2
MATH2605	Operational Research and Monte Carlo Methods	20	S2
MATH2607	Mathematical Programming	20	S1
BPIE213	Stage2 Mathematics Placement Preparation	0	AY

Optional Placement Year

BPIE331: Mathematics and Statistics Placement

Stage 4 Core and Restricted Modules

Students must take **one and only one** of the following modules.

Module Code	Module Title	Credit	Semester
MATH3625	High Performance Computing in Context	20	S2
MATH3616	Professional Experience in Industry	20	S1
MATH3628	Project	40	AY

NOTE: MATH3616 is assessed in S1 on the basis of placement work in the summer. Students taking this module will therefore have an increased workload in S1 if they take 60 S1 credits. MATH3628 is a 40 credit module running all year.

Students **must** take the following modules

Module Code	Module Title	Credit	Semester
MATH3605	Partial Differential Equations	20	S1
MATH3613	Data Modelling	20	S1
MATH3609	Optimisation, Networks and Graphs	20	S2

Stage 4 Optional Modules

Module Code	Module Title	Credit	Semester
MATH3604‡	Geometry and Algebra	20	S2
MATH3629‡	Fluid Dynamics	20	S1
MATH3606	Classical and Quantum Mechanics	20	S1
MATH3623‡	Financial Statistics	20	S1
MATH3611‡	Electrodynamics and Relativity	20	S2
MATH3612	Dynamical Systems	20	S2

‡NOTE: The following pairs of modules cannot be taken together: 3623/3629, 3611/3604

7. Programme Aims

This programme aims to:

1. foster knowledge and understanding of a broad range of mathematical topics, techniques and skills with an additional emphasis on high performance computing;
2. foster an awareness of the power, breadth, range of applications and limitations of the subject
3. encourage students to be independent and adaptable learners;
4. equip students with the skills necessary for future employment or further study.

8. Programme Intended Learning Outcomes

8.1. Knowledge and understanding

On successful completion graduates should have developed:

1) a good level of skill in deploying methods, techniques and results from a range of major areas of mathematics and high performance computing;
2) a systematic understanding of
   - the importance of logical argument in mathematics;
   - the processes and pitfalls of numerical computation;
   - the need to solve problems rigorously and in generality;
3) an appreciation of the process of mathematical thinking, an awareness of assumptions made and consequences of assumptions being violated; the applications of such thinking to parallel computation;
4) an ability to formulate realistic problems mathematically using a range of techniques, and to interpret the results.

8.2. Cognitive and intellectual skills

On successful completion graduates should have developed:

1) the ability to identify the essentials of a problem in mathematics and computing;
2) formulate and solve such problems;
3) evaluate the limitations of the analysis;
4) to present arguments and conclusions effectively and accurately.

8.3. Key and transferable skills

On successful completion graduates should have developed the ability to:

1) use appropriate ICT such as spreadsheets, word-processors, the internet and specialist software;
2) communicate effectively through the spoken word and in a variety of written formats;
3) learn independently using a variety of media including books, journals and the internet;
4) work independently and organise his/her own learning;
5) transfer skills and apply them in new contexts.

8.4. Employment related skills

On successful completion graduates should have developed:

1) the professional exercise of personal and inter-personal skills;
2) effective communication skills
3) the independent learning ability required for continuing professional development;
4) a broad knowledge of those aspects of mathematics and high performance computing which could be required in future employment.

8.5. Practical skills

On successful completion graduates should be:

1) able to use specialist software accurately and effectively;
2) able to work effectively in a team.

9. Admissions Criteria, including APCL, APEL and DAS arrangements

All applicants must have GCSE (or equivalent) Maths and English at Grade C or above. International students should have IELTS 6.0 or equivalent. APCL/APEL will be considered on an individual basis.

Entry Requirements for all BSc (Hons) Programmes in Mathematics	
A-level/AS-level	A typical offer is 120 points to include minimum of 2 A levels, including grade B in A level Mathematics or B in Further Mathematics or A level Mathematics and Statistics or Math (Pure and Applied) excluding general studies. Mathematics (mechanics) accepted as mathematics.
BTEC National Diploma/QCF Extended Diploma	All such candidates will be interviewed individually and a diagnostic test may be required. DDM grades are needed with a distinction in a mathematical subject.
Access to Higher Education at level 3	Acceptance is conditional upon an interview and, generally, a diagnostic test. The Access course must be passed with at least 33 credits at Merit and/or Distinction and should include at least 12 credits in Maths units with Merit.
Welsh Baccalaureate	Treat as standard offer, i.e. can accept as add on points of 120 but must have 2 A Levels and Mathematics grade A.
Scottish Qualifications Authority	320 points including Mathematics grade A in Advanced Highers Mathematics.
Irish Leaving Certificate	AABBB at Higher Level, to include grade A in Mathematics.
International Baccalaureate	30 overall to include 5 at HL Mathematics. If overseas and not studying English within IB, must have IELTS 6.0 overall with 5.5 in all other elements.
Progression from FPT	Students may progress automatically from two of the pathways: Mathematics and Statistics with Foundation Year and, also, from any of the Engineering with Foundation Year courses. It is required that they have gained at least 50% overall.

Applicants with non-standard qualifications are considered individually.

Applicants with disabilities are encouraged to talk to staff in Disability Assist about the assistance available from the University. Students with disabilities which they feel will impact on their studies are usually invited for an information interview with members of Disability Assist and teaching staff in order to discuss the student's requirements in more detail. This would normally take place after an application has been made through UCAS, though informal discussions can take place before this.

10. Progression criteria for Final and Intermediate Awards

Honours degree: 360 credits, including 120 credits at Level 6, 120 credits at Level 5 or above and 120 credits at Level 4 or above.

Ordinary degree: 320 credits, including 80 credits at Level 6, 120 credits at Level 5 or above and 120 credits at Level 4 or above

Diploma of Higher Education: 120 credits at level 5.

Certificate of Higher Education: 120 credits at level 4

11. Exceptions to Regulations

None

12. Transitional Arrangements

2016/17 Modules	2017/18 Modules
MATH3610	MATH3629
MATH3617	MATH3625
MATH3618	MATH3628

13. Mapping and Appendices:

13.1. ILO's against Modules Mapping

Intended Learning Outcomes Map	Honours Degree Level		
1 Graduate Attributes and Skills	**2**	**3**	**4**
Core Programme Intended Learning Outcomes (as worded in the Programme Specification)	**Aim(s)**	**Subject Benchmark**	**Related Core Modules**
Knowledge/ Understanding			
1) a high level of skill in deploying methods, techniques and results from a range of major areas of mathematics and high performance computing;	1	B 3.9,-11 5.13/15	MATH1601-1606 MATH2601-2607 MATH3604-3628

2) a systematic understanding of			
○ the role of logical argument in mathematics; ○	1	B 3.14-15, 5.13/15	MATH1601-2607 MATH3604-3628
○ the processes and pitfalls of numerical computation;	1	B 3.16-17	MATH1606/2603,5,7 MATH3605/3625/3628
○ the need to solve problems rigorously and in generality.	1	B 3.24	MATH1601,2,4
3) an appreciation of the process of mathematical thinking, an awareness of assumptions made and consequences of assumptions being violated; the applications of such thinking to parallel computation	2	B 3.14-15	MATH2601-2607 MATH3604-3628
4) an ability to formulate realistic problems mathematically using a range of techniques, and to interpret the results.	2	B 3.16-17	MATH2601-2607 MATH3604-3628
Cognitive / Intellectual Skills			
1) the ability to identify the essentials of a problem in mathematics and computing	2	ALL: B 3.23 B 5.13/15	ALL: MATH1601-1606 MATH2601-2607 MATH3604-3628
2) formulate and solve such problems	2		
3) evaluate the limitations of the analyses	2		
4) to present arguments and conclusions effectively and accurately	2,4	B 5.13/15	MATH3604-3528

Key / Transferable Skills			
1) use appropriate ICT such as spreadsheets, word-processors, the internet and specialist software;	4	B 3.27	MATH1601,5,6 MATH2602,3,5,7 MATH3605,25,28
2) communicate effectively through the spoken word and in a variety of written formats;	4	B 3.25	MATH1601-2607 MATH3625/3628 With personal tutors
3) learn independently using a variety of media including books, journals and the internet;	3	B 3.27	With personal tutors MATH3625/3628
4) work independently and organise his/her own learning;	3	B 3.27, 5.13/15	With personal tutors MATH3625/3628
4) transfer skills and apply them in new contexts.	3	B 3.25, 5.13/15	MATH3625-3628
Employment-related Skills			
1) the professional exercise of personal and inter-personal skills	3,4	B 3.27	MATH3625/3628
2) effective communication skills	4	B 3.16-17 B 3.27	MATH3625/3628 With personal tutors
3) the independent learning ability required for continuing professional development	3,4	B 3.27	MATH3604-3628
4) a broad knowledge of those aspects of mathematics and high performance computing which could be required in future employment	4	B 3.23 B 3.25	MATH3604-3628
Practical Skills			
1) able to use specialist software accurately and effectively.	1,4		MATH1601,5,6 MATH2602,3,5,7 MATH3605,25,28
2) able to work effectively in a team			MATH2605, MATH3625.

13.2. Assessment against Modules Mapping

Module	Title	C/W	Test	Practice	Exam
MATH1601	Mathematical Reasoning	100	0	0	0
MATH1602	Calculus and Analysis	40	0	0	60
MATH1603	Linear Algebra and Complex Numbers	40	0	0	60
MATH1604PP	Symmetry and Space	100			
MATH1605	Probability with Applications	40	0	0	60
MATH1606	Numerical and Computational Methods	40	0	0	60
MATH1608PP	Understanding Big Data from Social Networks	100	0	0	0
MATH2601	Advanced Calculus	30	0	0	70
MATH2602	Statistical Inference and Regression	30	0	0	70
MATH2603	Ordinary Differential Equations	30	0	0	70
MATH2604	Mathematical Methods and Applications	30	0	0	70
MATH2605	Operational Research and Monte Carlo Methods	75	0	25	0
MATH2607	Mathematical Programming	100	0	0	0
MATH3603	Professional Experience in Mathematics Education	80	0	20	0
MATH3606	Classical and Quantum Mechanics	30	0	0	70
MATH3623	Financial Statistics	30	0	0	70

MATH3629	Fluid Dynamics	30	0	0	70
MATH3611	Electrodynamics and Relativity	30	0	0	70
MATH3612	Dynamical Systems	30	0	0	70
MATH3613	Data Modelling	30	0	0	70
MATH3616	Professional Experience in Industry	100	0	0	0
MATH3625	HPC in context	70	0	30	0
MATH3628	Project	80	0	20	0

13.3. Skills against Modules Mapping

Module	Presentation skills	ICT programming	Team work	Reflective Skills	Research Skills
MATH1601	✓	✓	✓	✓	✓
MATH1602			✓		
MATH1603				✓	
MATH1604PP				✓	✓
MATH1605		✓			
MATH1606	✓	✓	✓		
MATH1608PP		✓		✓	✓
MATH2601		✓	✓		
MATH2602		✓			
MATH2603	✓	✓	✓	✓	
MATH2604	✓	✓	✓		✓
MATH2605	✓	✓	✓	✓	✓
MATH2607	✓	✓	✓		✓
MATH3605	✓	✓	✓		
MATH3606		✓			
MATH3623	✓	✓	✓		
MATH3609	✓	✓	✓	✓	✓
MATH3629	✓	✓	✓	✓	✓
MATH3611		✓			
MATH3612		✓			
MATH3613	✓	✓	✓		

MATH3616	✓	✓	✓		
MATH3625	✓	✓	✓	✓	✓
MATH3628	✓	✓		✓	✓