Programme Specification

Integrated PhD in Mathematical Sciences (2020-21)

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Awarding Institution	University of Southampton
Teaching Institution	University of Southampton
Mode of Study	Full-time
Duration in years	5
Accreditation details	None
Final award	Doctor of Philosophy (PhD)
Name of Award	Integrated PhD in Mathematical Sciences
Interim Exit awards	Master of Philosophy (MPhil) Master of Science (MSc) Postgraduate Diploma in Higher Education
FHEQ level of final award	Level 8
UCAS code	
Programme Code	7154
QAA Subject Benchmark or other external reference	Mathematics, Statistics And Operational Research 2007
Programme Lead	Jelena Grbic (jg1u11)
Pathway Lead	

Programme Overview

Brief outline of the programme

This is a programme whose regulations fall under those for an Integrated PhD as outlined in the University Calendar. Candidates are required to undertake the scheme of study over a period of four years full-time registration, to pass the required examinations, and to submit a thesis not more than 12 months later than the end of the fourth year of study. In exceptional circumstances the Faculty Graduate School directorate may approve a later date for submission. If part-time candidates are permitted, they are required to submit a thesis not more than 12 months later than the end of the seventh year of study.

In the first year, students follow a taught programme of Level 7 modules selected from across a range to be approved by the programme director in consultation with the supervisory team. Following successful completion of the taught element, students embark on their individual research programme. In all years, the programme provides an integrated series of training modules to help students to develop professional and personal skills as well as scientific expertise.

The research work of each student will be closely supervised and supported, particularly during the research phase of the programme. The student will be monitored according to the progression milestones in the regulations for the Integrated PhD in a Named Subject and the Code of Practice for Research Candidature and Supervision.

Your contact hours will vary depending on your module/option choices. Full information about contact hours is provided in individual module profiles.

Learning and teaching
The taught component of the programme follows the regulations for the taught component of a stand-alone Master's degree as specified in Section 4 of the Calendar. It comprises courses which account for 60 ECTS points of modules, with a minimum of 45 ECTS/90 CATS points at level 7.
Core and optional modules are as follows.

Assessment
Assessment in the taught element of the programme follows the regulations for the taught component of a Stand-alone Master's degree as specified in Section IV of the Calendar. Examination and assessment is conducted at the end of each semester and as necessary in summer referral exams.

Assessment in the research element of the programme follows the regulations for an Integrated PhD in a named degree as specified in Section V of the Calendar.

Year 1 (years 1 and 2 when studied part-time) comprises the two full semesters of taught material at level 7 (60 ECTS/120 CATS) provided by the University of Southampton to both broaden and deepen the mathematical knowledge of the student in preparation for research. Assessment and examination will take place at the end of each semester.

Progression onto the research element of the programme is determined by satisfactory completion of the taught element. Including MATH6144 (MMath Project) students must achieve an average Pass Mark of at least 60% with a Pass Mark of 60% in 45 ECTS at Level 7. All other modules must be passed as outlined in the Stand-alone Master's degree as specified in Section IV of the Calendar.

Students who fail the assessment for the taught element may be referred in the summer referral exams. Students undergoing referral in the taught element of their programme may, with the approval of the Programme Director, commence the research element of their programme immediately after month 8. However they may only submit their annual research report and thesis following successful referral.

On completing study for the taught element of the programme those candidates who do not satisfy the requirements for progression to the research phase of the programme, may be considered for the exit award of a Postgraduate Diploma as governed by the regulations for that award.

Progression in the research element of the programme is monitored, assessed and governed by the regulations for the degree of Integrated PhD in a Named Subject as specified in the Calendar, and the Code of Practice for Research Candidature and Supervision.

The regulations governing the submission for, assessment and award of this degree are those concerning an Integrated PhD in a Named Subject. The named award is PhD in Mathematical Sciences.

Students who have progressed to the research component who exit the programme early may be considered for the award of an MPhil if they have demonstrated the criteria specified for this award in the University's Code of Practice.

Special Features of the programme

At the end of the taught element of the programme, students may be offered the opportunity to engage in a 3 month long summer project related to their main area of study. This project can be provided in collaboration with an industrial, governmental, charitable or financial organization and the placement will be organized with the support of the AU Industrial Liaison Officer. Approval for the proposed placement must be granted by the Doctoral Programme Director in consultation with the supervisory team. Any placement is subject to the satisfactory completion and approval of a risk assessment, conducted under the University's standard procedures.

Please note: As a research-led University, we undertake a continuous review of our programmes to ensure quality enhancement and to manage our resources. As a result, this programme may be revised during a student's period of registration; however, any revision will be balanced against the requirement that the student should receive the educational service expected. Please read our Disclaimer to see why, when and how changes may be made to a student's programme.

Programmes and major changes to programmes are approved through the University's programme validation process which is described in the University's Quality handbook.

Educational Aims of the Programme

The aims of the programme are to:

- Provide knowledge and understanding of a chosen area of mathematics at an advanced level and training in established research techniques appropriate to the area;
- Develop a capacity in students for original research based on a thorough understanding of their chosen field in collaboration with their supervisor;
- Provide students with a broader and deeper knowledge of graduate level mathematics and its application;
- Produce theses and subsequent publications that contribute to the development of and understanding of the chosen area of mathematics;
- Offer students a supportive environment so that they feel that they are part of a community of scholars and are well placed to pursue a career building on their accomplished research;
- Give students the opportunity to present their work to colleagues, and to bring the student into contact with the wider research community, enabling them to build networks with others researching in the same field.

Programme Learning Outcomes

Knowledge and Understanding

On successful completion of this programme you will have knowledge and understanding of:

A1. Having successfully completed the taught element of this programme a student will be able to demonstrate:

A deep, advanced understanding of a range of topics relevant to the active research themes in the academic unit of mathematical sciences.

A2. Having successfully completed the taught element of this programme a student will be able to demonstrate:

An understanding of the context of, and the relationship between, the taught component and the likely research direction.

A3. Having successfully completed the research element of this programme a candidate will be able to demonstrate:

a proper command of the literature, including knowledge of critical open problems, as well as facility in the use of established techniques in the fields of study;

A4. Having successfully completed the research element of this programme a candidate will be able to demonstrate:
a systematic acquisition and understanding of a substantial body of knowledge in mathematics and/or statistics which is at the forefront of the discipline;

Teaching and Learning Methods

Acquisition of knowledge and understanding is through structured exposition based on lectures, computer workshops, private study, seminars, case studies, individual and group coursework, and individual supervision under the guidance of a first supervisor, with further contributions from other members of the supervisory team.

Assessment Methods

Modules in the taught element are assessed by a combination of unseen examinations and/or coursework. Examinations and assessment in the taught component is conducted at the end of each semester and as necessary in summer referral exams. The research component is assessed by thesis and viva as governed by the regulations for an Integrated PhD in a Named Subject. Skills and knowledge will be monitored and assessed throughout the programme under the milestone reviews conducted by the Graduate School.

Subject Specific Intellectual and Research Skills

On successful completion of this programme you will be able to:

B1. Having successfully completed the taught element of this programme a student will be able to demonstrate Technical skills in the use of appropriate mathematical and/or statistical techniques.

B2. Having successfully completed the taught element of this programme a student will be able to demonstrate critical and analytical skills using a range of appropriate mathematical and/or statistical techniques.

B3. Having successfully completed the research element of this programme a candidate will be able to demonstrate the ability to create and interpret new knowledge in the field of mathematics and/or statistics through original research or other advanced scholarship, of a quality to satisfy peer review, extending the forefront of the discipline;

B4. Having successfully completed the research element of this programme a candidate will be able to demonstrate the general ability to conceptualize, design and implement a project for the generation of new knowledge, applications or understanding at the forefront of the mathematical sciences, and to adjust the project design in the light of unforeseen problems;

B5. Having successfully completed the research element of this programme a candidate will be able to demonstrate a detailed understanding of applicable techniques for research and advanced academic enquiry.

Teaching and Learning Methods

Acquisition of knowledge and understanding is through structured exposition based on lectures, computer workshops, private study, seminars, case studies, individual and group coursework, and individual supervision under the guidance of a first supervisor, with further contributions from other members of the supervisory team.

Assessment Methods

Modules in the taught element are assessed by a combination of unseen examinations and/or coursework. Examinations and assessment in the taught component is conducted at the end of each semester and as necessary in summer referral exams. The research component is assessed by thesis and viva as governed by the regulations for an Integrated PhD in a Named Subject. Skills and knowledge will be monitored and assessed throughout the programme under the milestone reviews conducted by the Graduate School.

Transferable and Generic Skills

On successful completion of this programme you will be able to:

C1. Having successfully completed the taught element of this programme a student will be able to demonstrate the ability to communicate advanced ideas clearly in a range of formats.
C2. Having successfully completed the taught element of this programme a student will be able to demonstrate the ability to use IT to support their learning and research.
C3. Having successfully completed the research element of this programme a candidate will be able to demonstrate the ability to use logical argument, deductive reasoning and analysis, abstraction and generalization to solve complex problems and to report their findings;
C4. Having successfully completed the research element of this programme a candidate will be able to demonstrate the ability to identify their further training needs and to take responsibility for their own professional de-velopment.

Teaching and Learning Methods

Acquisition of knowledge and understanding is through structured exposition based on lectures, computer workshops, private study, seminars, case studies, individual and group coursework, and individual supervision under the guidance of a first supervisor, with further contributions from other members of the supervisory team.

Assessment Methods

Modules in the taught element are assessed by a combination of unseen examinations and/or coursework. Examinations and assessment in the taught component is conducted at the end of each semester and as necessary in summer referral exams. The research component is assessed by thesis and viva as governed by the regulations for an Integrated PhD in a Named Subject. Skills and knowledge will be monitored and assessed throughout the programme under the milestone reviews conducted by the Graduate School.

Having successfully completed the this programme a candidate will be able to demonstrate the skills, knowledge and competencies appropriate to the award of a PhD, as specified in the Code of Practice for Research Candidature and Supervision.

Programme Structure

The programme structure table is below:

Information about pre and co-requisites is included in individual module profiles.

Pathway

Part I
Typical course content

All students will complete a one-year Masters level project chosen to prepare them for research. This will be delivered and assessed via the core module MATH6144 (15 ECTS/ 30 CATS).

Students will take a number of modules (comprising an additional 45 ECTS/90 CATS) from a range of

modules, at least 30 ECTS/60 CATS of these must be at level 7. Up to 15 ECTS/30 CATS may be chosen from approved alternative modules in related cognate areas.

The selection of modules, dependent on existing knowledge and qualifications,
will be chosen by the student in consultation with the supervisory team, and must be approved by the Doctoral Programme Director.

The full time programme runs over 60 months.

The option modules shown below constitute an indicative list; there will always be choice but the options might vary between years. A full list of modules and rules will be available to you via the Student Record Self-Service system once you enrol at the University.

Variations To Regulations:
Including MATH6144 (MMath Project) students must achieve an average Pass Mark of at least 60% with a Pass Mark of 60% in 45 ECTS at Level 7.

Part I Compulsory

Code	Module Title	ECTS	Type
MATH6144	MMath Project	15	Compulsory

Part I Optional
Select 45 ECTS (90 CATS)

You must select 45 ECTS (90 CATS) from ONE of the following groups:

Rule 1 Group 1 - Actuarial Sciences
Rule 1 Group 2 - Pure and Applied Mathematics
Rule 1 Group 3 - Operational Research
Rule 1 Group 4 - Statistics

At least 60 CATS must be from Level 7 modules. 30 CATS may be chosen from approved alternative modules in related cognate areas,

The selection of modules, dependent on existing knowledge and qualifications, will be chosen by the student in consultation with the supervisory team, and must be approved by the Doctoral Programme Director.

Part I Optional Actuarial Sciences
If selecting this group, please select 90 CATS from the following modules:

Code	Module Title	ECTS	Type
MANG6225	Accounting and Finance for Actuarial Science	7.5	Optional
MATH6129	Actuarial Mathematics I	7.5	Optional
MATH6130	Actuarial Mathematics II	7.5	Optional
MATH6121	Economics	7.5	Optional
MATH6131	Financial Mathematics	7.5	Optional
MATH6127	Mathematical Finance	7.5	Optional
MATH6122	Probability and Mathematical Statistics	7.5	Optional
STAT6075	Statistical Methods in Insurance	7.5	Optional
MATH6128	Stochastic Processes	7.5	Optional
MATH6143	Survival Models	7.5	Optional

Part I Optional Operational Research
If selecting this group, please select 90 CATS from the following modules:

Code	Module Title	ECTS	Type
MATH6119	Analytical Consultancy Skills	3.75	Optional

MATH6112	Computer-based statistical modelling	3.75	Optional
MANG6054	Credit Scoring and Data Mining	3.75	Optional
MANG6038	Data and Knowledge Management	7.5	Optional
MATH6002	Deterministic OR Methods	7.5	Optional
MATH6017	Financial Portfolio Theory	3.75	Optional
MATH6011	Forecasting	3.75	Optional
MANG6100	Game Theory for Business	3.75	Optional
MATH6005	Introduction to Python	3.75	Optional
MANG6229	Multivariate Statistics for Data Mining	3.75	Optional
MATH6120	Nonlinear Optimisation	3.75	Optional
MANG6292	Operations Management	3.75	Optional
MANG6049	Problem Structuring	3.75	Optional
MANG6293	Project Management	3.75	Optional
MANG6143	Project Risk Management	7.5	Optional
MANG6231	Software for Data Analysis and Modelling	3.75	Optional
MATH6006	Statistical Methods	7.5	Optional
MATH6004	Stochastic OR Methods	7.5	Optional

Part I Optional Pure and Applied Mathematics
If selecting this group, please select 90 CATS from the following modules:

Code	Module Title	ECTS	Type
MATH6139	Advanced General Relativity	7.5	Optional
MATH6094	Complex Function Theory	7.5	Optional
MATH6109	Differential Geometry and Lie Groups	7.5	Optional
MATH6138	Geometric Group Theory	7.5	Optional
MATH6155	Harmonic Analysis	7.5	Optional
MATH6137	Homotopy and Homology	7.5	Optional
MATH6079	Hyperbolic Geometry	7.5	Optional
MATH6095	Introduction to Semigroup Theory	7.5	Optional
MATH6149	Modelling with Differential Equations	7.5	Optional
MATH6156	Modules and Representations	7.5	Optional
MATH6140	Structure and Dynamics of Networks	7.5	Optional

Part I Optional Statistics
If selecting this group, please select 90 CATS from the following modules:

Code	Module Title	ECTS	Type
STAT6086	Sampling Techniques	5	Optional
STAT6108	Analysis of Hierarchical (Multilevel & Longitudinal) Data	5	Optional
MATH6157	Applied Statistical Modelling	7.5	Optional
MATH6025	Bayesian Methods	3.75	Optional
MATH6151	Clinical Trials	3.75	Optional
MATH6027	Design of Experiments	7.5	Optional
MATH6033	Epidemiological Methods	3.75	Optional
STAT6083	Generalised Linear Models	10	Optional
STAT6099	Research Communication Skills	5	Optional
MATH6152	Statistical Computing	5	Optional
MATH6068	Statistical Genetics	3.75	Optional
MATH6153	Statistical Theory and Linear Models	10	Optional
MATH6021	Survival Analysis	3.75	Optional
MATH6135	Topics in Statistics	7.5	Optional

Progression Requirements

The programme will follow the University's regulations for ***Progression, Determination and Classification of Results: Undergraduate and Integrated Masters Programmes*** or the University's regulations for ***Progression, Determination and Classification of Results: Standalone Masters Programmes*** as set out in the General Academic Regulations in the University Calendar:

http://www.calendar.soton.ac.uk/sectionIV/sectIV-index.html

Support for student learning

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline area.

The University provides:

- library resources, including e-books, on-line journals and databases, which are comprehensive and up-to-date; together with assistance from Library staff to enable you to make the best use of these resources
- high speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices; laptops, smartphones and tablet PCs via the Eduroam wireless network. There is a wide range of application software available from the Student Public Workstations.
- computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources)
- standard ICT tools such as Email, secure filestore and calendars.
- access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move.
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Hartley Library.
- Enabling Services offering support services and resources via a triage model to access crisis management, mental health support and counselling. Support includes daily Drop In at Highfield campus at 13.00 – 15.00 (Monday, Wednesday and Friday out of term-time) or via on-line chat on weekdays from 14.00 – 16.00. Arrangements can also be made for meetings via Skype.
- assessment and support (including specialist IT support) facilities if you have a disability, long term health problem or Specific Learning Difficulty (e.g. dyslexia)
- the Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards
- Career and Employability services, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV.
- Other support that includes health services (GPs), chaplaincy (for all faiths) and 'out of hours' support for students in Halls and in the local community (18.00-08.00).
- A Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers.

The Students' Union provides

- an academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University.
- opportunities for extracurricular activities and volunteering
- an Advice Centre offering free and confidential advice including support if you need to make an academic appeal
- Support for student peer-to-peer groups, such as Nightline.

During the research years of the programme, you will have access to:

· Your personal computer for your research;

· The University's supercomputer for computer intensive tasks, in consultation with your supervisory team;

· The AU's electronic printing facilities for the production of papers and material for theses;

· Financial support for travel and conference arrangements subject to approval from your supervisory team;

· The AU's range of seminar talks given by invited speakers on a wide range of topics;

· Enhancing your teaching skills, subject to satisfactory completion of formal training requirements;

· General training events offered through the Faculty's Grad School, covering a wide range of generic research-enhancing topics;

· Subject-specific training opportunities as specified through annual training reviews with your supervisory team.

Methods for evaluating the quality of teaching and learning

You will have the opportunity to have your say on the quality of the programme in the following ways:

Candidates have the opportunity to comment on the quality of the programme in the following ways:

· Completing student evaluation questionnaire for each module of the programme;
· Acting as a student representative on various committees, e.g. Staff-student liaison committees, faculty programmes committee, or providing comments to student representatives to feed back on their behalf;
· Serving as a student representative on faculty scrutiny groups for programme validation;
· Taking part in programme validation meetings by joining a panel of students to meet with the faculty scrutiny Group.

The ways in which the quality of the programme is checked, both inside and outside the University, are:

· Regular module and programme reports which are monitored by the Faculty;
· Programme validation, normally every five years;
· External examiners, who produce an annual report;
· A national Research Assessment Exercise (our research activity contributes directly to the quality of your learning experience);
· Institutional Review by the Quality Assurance Agency.

Further details on the University's quality assurance processes are given in the *Quality handbook*.

Career Opportunities

With leading academics, a multidisciplinary approach and a superb record for the quality of our teaching and our research, Mathematical Sciences offers a vibrant and supportive environment for postgraduate students. Mathematical Sciences has one of the broadest communities of mathematicians in the UK, spanning pure and applied mathematics, statistics and operational research. Our research includes internationally-recognised projects with partners in engineering, physical and biological sciences and social sciences. We place great importance on the development of graduate skills vital for future employment by adding transferrable skills into learning and teaching.

A PhD is recognised by employers across a wide range of sectors. Our postgraduate research students are highly sought after by other universities, business and industry, NGOs and governments worldwide.

External Examiner(s) for the programme

Name: Mr Peter J Savill - Fellow of the Institute of Actuaries

Name: Dr Lawrence Pettit - Queen Mary College University of London

Name: Professor John Parker - University of Durham

Name: Dr Jonathan Thompson - Cardiff University

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff: Student Liaison Committees will have the opportunity to consider external examiners' reports as part of the University's quality

assurance process.

External examiners do not have a direct role in determining results for individual students, and students wishing to discuss their own performance in assessment should contact their Personal Academic Tutor in the first instance.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided. More detailed information can be found in the programme handbook.

Appendix 1:

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. In addition to this, students registered for this programme also have to pay for:

Additional Costs

Type	Details
Software Licenses	Some modules may involve lab sessions or coursework where you practice certain specialised software products. The University will enable you to have access to such software without the need for you to pay for a software license.
Hardware	You will be able to use University computers at various locations including the Library to write reports or interact with software programmes as necessary. It may be very useful for you to use your own laptop device for certain tasks if you want to work at your own preferred locations such as your home, but be aware that in case this device gets damaged you may lose valuable files – therefore it is important to always safe your work on your University student account as a backup in addition to saving any work on separate hardware devices in case you don't have immediate access to your University account. Reporting failure of your own laptop is not a valid excuse to being late with e.g. a coursework submission!
Computer discs or USB drives	You may find it useful to purchase some USB memory sticks or other devices to store your per-sonal files. However these standalone devices may fail and therefore you should always take backups. As a student enrolled at the University you will be able to safe your own computer files on an account so that you can access them from multiple University computers. This is also considered a safe way of keeping backups of all your files.
Stationery	You will be expected to provide your own day-to-day stationery items, e.g. pens, pencils, note-books, etc. Any specialist stationery items will be specified under the Additional Costs tab of the relevant module profile.
Textbooks	Where a module specifies core texts these should generally be available on the reserve list in the library. However due to demand, students may prefer to buy their own copies. These can be purchased from any source. Some modules suggest reading texts as optional background reading. The library may hold copies of such texts, or alternatively you may wish to purchase your own copies. Although not essential reading, you may benefit from the additional reading materials for the module.
Placements (including Study Abroad Programmes)	You may be offered the opportunity at the end of the taught programme to undertake a three month long summer project relevant to your programme. This may be in collaboration with an organisation. How expenses for traveling and accommodation are covered is dependent on the particular case and you may want to discuss this during semester 2 with the AU Industrial Liai-son Officer.
Approved Calculators	Candidates may use calculators in the examination room only as specified by the University and as permitted by the rubric of individual examination papers. The University approved model is Casio FX-570 This may be purchased from any source and no longer needs to carry the Univer-sity logo.
Optional Visits (e.g. museums, galleries)	Some modules may include optional visits to a museum, galleries, businesses, etc. You will normally be expected to cover the cost of travel and admission, unless otherwise specified in the module profile.
Printing and Photocopying Costs	In the majority of cases, coursework such as essays; projects; dissertations is likely to be sub-mitted on line. However, there are some items where it is not possible to submit on line and students will be asked to provide a printed copy. A list of the University printing costs can be found here: http://www.southampton.ac.uk/isolutions/students/printing-for-students.page. For students undertaking modules with a high mathematical content, some assessed work will be submitted in handwritten hard copy format. Students are advised that they will need to bear the costs of the required stationery.

In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at www.calendar.soton.ac.uk.