ROYAL HOLLOWAY
University of London

PROGRAMME SPECIFICATION

This document describes **Honours Degree and Honours MSci Degree programmes in Mathematics**. For Joint and Combined Honours Degree programmes, please also refer to the equivalent document(s) for the other subject(s). This specification is valid for new entrants from **September 2018**.

The aims of all Honours Degree programmes and the Honours MSci Degree programme in Mathematics are:
- to provide students with technical manipulative skills, the ability to read and write in the compressed language of mathematics, and the ability to distil a problem into a mathematical description of its essential detail;
- to ensure that students gain an appreciation of, and interest in, the logical structure of mathematics, and its use as an analytical and predictive tool in applications;
- to offer a wide range of optional course units to suit students' interests and strengths;
- to provide access to personal, academic and pastoral support;
- to enable students, on graduation, to compete effectively in employment or postgraduate study.

Programmes are delivered in either three stages (BSc) or four stages (MSci), each of which comprises one year of full-time study during which the student must follow courses to the value of 120 credits.

In Stage one students must take eight courses. In the eight mandatory courses it seeks to provide a broadly based introduction to mathematics, which will develop manipulative skills, understanding of the key concepts and the ability to construct logical arguments.

In Stage two, students must take eight courses, which continue their study of abstract pure mathematics and its applications.

In Stage three, students choose eight courses. Students are advised on appropriate combinations and pathways depending on their interests, Stage one and two options, and possible future career paths. They may choose to undertake an extended project.

In Stage four, students must undertake the project course MT4000 (30 credits) and choose six options (to the value of 90 credits)from Stage 4 only.

The programme structures will obviously vary depending on the chosen programme of study. A list of all programmes related to Mathematics and their specific structures can be found further into this document.

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This document provides a summary of the main features of the programme(s), and of the outcomes which a student might reasonably be expected to achieve if full advantage is taken of the learning opportunities provided. Further information is contained in the College prospectus, the College Regulations and in various handbooks issued to students upon arrival. Whilst Royal Holloway keeps all its information for prospective applicants and students under review, programmes and the availability of individual courses are necessarily subject to change at any time, and prospective applicants are therefore advised to seek confirmation of any factors which might affect their decision to follow a specific programme. In turn, Royal

Holloway will inform applicants and students as soon as is practicable of any substantial changes which might affect their studies.

Learning outcomes
Teaching and learning in the programme are closely informed by the active research of staff. In general terms, the programmes provide opportunities for students to develop and demonstrate the following learning outcomes:

Knowledge and understanding
- of mathematical methods;
- of mathematical concepts such as number and function;
- of abstract structures such as groups, matrices, and fields;
- of some results from a range of major areas of mathematics, statistics or operational research;
- of at least one major area of applications in which the mathematics is used in a serious manner and is essential for proper understanding;

Skills and other attributes
- a high level of numeracy;
- ability to manipulate and analyse complex mathematical expressions accurately;
- ability to understand the role of logical mathematical argument and deductive reasoning, including formal proof;
- familiarity with computer methods in mathematics and statistics;
- ability to formulate problems in mathematical or statistical form using appropriate notation;
- the ability to solve equations or inequalities arising from a problem analytically or numerically, and to interpret the results;
- accurate analysis of a situation, the factors involved and possible approaches to solution. This is embedded in a general ethos of numeracy and of analytical approaches to problem solving;
- ability to take theoretical knowledge gained in one area and apply it elsewhere;
- ability to make a sequence of logical steps, and reflect on the result;
- ability to communicate mathematical results clearly, to both mathematicians and lay persons;
- spatial awareness in two and three dimensions;
- good general skills of time-management and organization;*
- to learn independently, using a variety of media including books, learned journals, the internet etc;*
- to work independently with persistence and patience, pursuing the solution of problems to their conclusion;*
- develop IT skills, including word-processing and use of the internet;*
- personal motivation and the planning of a career path;*
- good written and oral communication skills, which enable them to write coherently and turn a rough draft into a convincing argument and contribute to discussions;*
- ability to work together with others as a team.*

* transferable skills

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Teaching, learning and assessment
Teaching and learning is mostly by means of lectures, small group tutorials, problem-solving workshop sessions, written and oral feedback on coursework, practical sessions in statistics and computational mathematics, guided independent study and oral presentations. Students are in addition encouraged to read around the subject, and at the end of the first and second stages they write essays or projects on topics of their own choice. Assessment is typically by formal examinations and in certain courses in-term tests, projects, coursework essays and oral presentations. Full details of the assessment methods for individual courses may be obtained from the Department.

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Details of the programme structure(s)

Please note that not all courses run each year. A full list of courses including optional courses for the current academic year can be obtained from the Department.

Single Honours Degree programmes and Combined Honours programmes taught wholly within Mathematics

Stage one:

Students following BSc Mathematics (**G100),** MSci Mathematics **(G103)** must take:
- MT1100 From Euclid to Mandelbrot (15 credits) condonable
- MT1710 Calculus (15 credits) condonable
- MT1720 Functions of Several Variables (15 credits) condonable
- MT1810 Number Systems (15 credits) condonable
- MT1820 Matrix Algebra (15 credits) condonable
- MT1940 Numbers and Functions (15 credits) condonable
- MT1210 Introduction to Applied Mathematics (15 credits) condonable
- MT1300 Principles of Statistics (15 credits) condonable

Students following BSc Mathematics with Statistics (**G1G3)** must take: MT1100, MT1710, MT1810, MT1940, MT1300, MT1720, MT1820 and MT1210.

Stage two:

Students following BSc Mathematics (**G100),** MSci Mathematics **(G103)** must take:
- MT2800 Linear Algebra and a Group Project (15 credits) condonable
- MT2900 Complex Variable (15 credits) condonable
- MT2940 Real Analysis (15 credits) condonable

plus 75 credits of options from a list of Stage two courses offered by the department.

Students following BSc Mathematics with Statistics (**G1G3)** must take:
- MT2800 Linear Algebra and a Group Project (15 credits) condonable
- MT2320 Probability (15 credits) condonable
- MT2900 Complex Variables (15 credits) condonable
- MT2300 Linear Statistical Methods (15 credits) condonable

and 60 credits of options from a list of Stage two courses offered by the department.

Stage three:

Students following BSc Mathematics (**G100),** MSci Mathematics **(G103)** must take eight options (120 credits) from a list of Stage three courses offered by the department.

Students following BSc Mathematics with Statistics (**G1G3)** must take
- MT3320 Inference (15 credits) condonable
- MT3340 Time Series Analysis (15 credits) condonable
- MT3360 Applied Probability (15 credits) condonable

plus 75 credits of options from a list of Stage three courses offered by the department.

Students taking BSc Mathematics (**G100),** MSci Mathematics **(G103) and** BSc Mathematics with Statistics **(G1G3)** may also choose options from the Stage four list if they wish. Students are advised on appropriate combinations and pathways depending on their interests, Stage one and two options, and possible future career paths. They may choose to undertake an extended project as MT3000.

Stage four:

Students following MSci Mathematics (**G103**) must take:
- MT4000 MSci Project (30 credits) Non-condonable

and 90 credits of options from the list of Stage four courses offered by the department. All stage four courses exist also in stage three versions. In stage four, you can only take level 7 courses (with a prefix of MT4XXX) and you cannot take the stage four version of a course if you have already taken the stage three version.

Combined Honours Degree programmes with Mathematics as a major or minor element

Stage one:

Students following BSc Mathematics with Management (**G1N2**) must take: MT1710, MT1810, MT1940, MT1300, MT1720, MT1820 plus 30 credits from appropriate courses taught in the School of Managements.

Students following BSc Mathematics with French (**G1R1**), BSc Mathematics with German (**G1R2**), BSc Mathematics with Italian (**G1R3**), BSc Mathematics with Spanish (**G1R4**), BSc Mathematics with Philosophy (**G1V5**) must take: MT1710, MT1810, MT1940, MT1720, MT1820 and one option from MT1210, MT1300 and MT1100 plus 30 credits from appropriate courses taught in their other departments.

Students following BA French with Mathematics (**R1G1**), BSc Management with Mathematics (**N2G1**) must take: MT1810, MT1820 plus 90 credits from appropriate courses taught in their other departments.

Students following BSc Mathematical Studies (**G150**) must take: MT1710, MT1300, MT1720, MT1810, MT1820, plus one from MT1100 or MT1940, and 30 credits from appropriate courses. Students should refer to the programme handbook and speak to the programme director for more details.

Stage two:

Students following BSc Mathematics with Management (**G1N2**) must take: MT2300, MT2800, MT2900 plus 45 credits of options from the list of stage two courses offered by the Department and 30 credits from appropriate courses taught in the School of Management.

Students following BSc Mathematics with French (**G1R1**), BSc Mathematics with German (**G1R2**), BSc Mathematics with Italian (**G1R3**), BSc Mathematics with Spanish (**G1R4**), BSc Mathematics with Philosophy (**G1V5**) must take: MT2800, MT2900 plus choose 60 credits of options from the list of stage two courses offered by the Department and 30 credits from appropriate courses taught in their other departments.

Students following BA French with Mathematics (**R1G1**), BSc Management with Mathematics (**N2G1**) must take 30 credits of options from the list of stage two courses offered by the Department and 90 credits from appropriate courses taught in their other departments.

Students following BSc Mathematical Studies (**G150**) must take: MT2800, MT2900, plus choose 60 credits of options from the list of stage two courses offered by the Department and 30 credits from appropriate courses. Students should refer to the programme handbook and speak to the programme director for more details.

Stage three:
Students following BSc Mathematics with Management (**G1N2**), BSc Mathematics with French (**G1R1**), BSc Mathematics with German (**G1R2**), BSc Mathematics with Italian (**G1R3**), BSc Mathematics with Spanish (**G1R4**), BSc Mathematics with Philosophy (**G1V5**) choose 90 credits of options from the list of stage three courses offered by the Department and 30 credits from appropriate courses taught in their other departments.

Students following BSc Mathematics with French (**R1G1**), BSc Management with Mathematics (**N2G1**) choose 30 credits of options from the list of stage three courses offered by the Department and 90 credits from appropriate

courses taught in their other departments.

Students following BSc Mathematical Studies **(G150)** () choose 90 credits of options from the list of stage three courses offered by the Department and 30 credits from the appropriate courses. Students should refer to the programme handbook and speak to the programme director for more details.

Joint Honours Degree programmes with Mathematics as an equal element

Stage one:

Students following BSc Computer Science and Mathematics (**GG41), **BSc Mathematics and Management **(GN12), **BSc Mathematics and Physics **(GF13), **MSci Mathematics and Physics **(GFC3), **BA Mathematics and Music **(GW13)** must take: MT1710, MT1810, MT1720, MT1820 plus 60 credits from appropriate courses taught in their other departments.

Students following BSc Economics and Mathematics (**LG11), **BSc Finance and Mathematics (**NG31)** must take: MT1710, MT1810, MT1300, MT1720, MT1820 plus 45 credits from appropriate courses taught in their other department.

Stage two:

Students following BSc Computer Science and Mathematics (**GG41)** must take: MT2630, MT2800 plus 30 credits of options from the list of stage two courses offered by the Department and 60 credits from appropriate courses taught in their other department.

Students following BSc Economics and Mathematics (**LG11), **BSc Finance and Mathematics (**NG31)** must take: MT2300, MT2630 plus choose a 15 credit option from the list of stage two courses offered by the Department and 75 credits from appropriate courses taught in their other department.*

Students following BSc Mathematics and Management **(GN12)** must take: MT2800, MT1300 plus choose 30 credits of options from the list of stage two courses offered by the Department and 60 credits from appropriate courses taught in their other department.

Students following BSc Mathematics and Physics **(GF13), **MSci Mathematics and Physics **(GFC3)** must take: MT2220, MT2720 plus 30 credits of options from the list of stage two courses offered by the Department and 60 credits from appropriate courses taught in their other departments.

Students following BA Mathematics and Music (**GW13)** must take: MT2800 plus choose 45 credits of options from the list of stage two courses offered by the Department and 60 credits from appropriate courses taught in the Department of Music.

Stage three:

Students following BSc Finance and Mathematics (**NG31)** must take MT3470 and MT3480 plus 30 credits of options from the list of stage three courses offered by the Department and 60 credits from appropriate courses taught in their other department.

Students **not** taking BSc Finance and Mathematics (**NG31)** have 60 credits of options from the list of stage three courses offered by the Department and 60 credits from appropriate courses taught in their other departments.

Stage four:

Students following MSci Mathematics and Physics **(GFC3)** must take either MT4000 (30 credits) or PH4100 (30 credits). In addition, they must take 45 credits from appropriate courses offered by the Mathematics Department,

and 45 credits from appropriate courses offered by the Physics Department.

Progression and award requirements

The progression and award requirements are essentially the same across all Honours Degree programmes at Royal Holloway as outlined in the College's Undergraduate Regulations. Students must pass units to the value of at least 90 credits on each stage of the programme. Failing marks of 30 – 39% can normally be condoned in up to 30 credits across stages 1 and 2. In the final stage failing marks in up to 30 credits can normally be condoned. However, on some programmes there may be a requirement to pass specific courses in order to progress to the next stage, or to qualify for a particular degree title and this will put restrictions on courses in which failing marks can be condoned (see programme structure above for details). Additionally there are requirements on the number of courses that must be passed in order to qualify for particular joint or combined Honours degree programmes.

Students are considered for the award and classified on the basis of a weighted average. For BSc awards this is calculated from marks gained in courses taken in Stages two and three, and gives twice the weighting to marks gained in Stage three. For the MSci this is calculated from marks gained in courses taken in Stages two, three and four and gives twice the weighting to marks gained in Stages three and four. The College's Undergraduate Regulations include full details on progression and award requirements for all undergraduate programmes offered by the College.

The Mathematics Department does not require that any specific course-units must be passed before progression to the next stage; however students must meet the standard progression requirements as per the undergraduate regulations and, where applicable, pass any mandatory non-condonable course units in other departments on each stage of the programme. To progress from stage two to the following stage in the MSci the student must achieve, at their first attempt, a stage average calculated to two decimal places of 50.00% or above. To progress from the third to the final stage of the MSci the student must achieve, at first attempt, a weighted stage average of 55.00% or above calculated to two decimal places, where the second stage average is weighted as 1 and the third stage average is weighted as 2. Students who fail to progress from stage two will be transferred to a B.Sc. programme.   M.Sci. students who fail to progress to the final stage will also be transferred to a B.Sc.

Students taking MSci Mathematics (**G103)** must pass MT4000 MSci Project to be eligible for the MSci award.

Students taking MSci Mathematics and Physics (**GFC3)** and who elect to take MT4000 MSci Project must pass this course to be eligible for the MSci award.

All first year students on single joint or combined honours programmes offered all or in part by departments or schools in the Faculty of Arts & Social Science are required to pass a Moodle-based writing skills quiz in order to progress into the second year of study. The pass mark for the test is 60%. Certificates of Distinction are awarded to students who achieve at least 80% in the quiz. Students may attempt the quiz as often as they wish with no penalties or capping. Students who meet the requirements for progression as stipulated in the College's Undergraduate Regulations (Section: Conditions for progression to the next stage) but fail to pass the Moodle-based quiz will not be permitted to progress into their second year of academic study at the College.

Student support and guidance
- Each student is allocated an adviser who meets with him or her regularly through the programme. The adviser's role is to guide the student's academic progress, and give advice on academic, pastoral and welfare issues. The Academic Coordinator and First Year Coordinator provide a back-up system for academic and pastoral advice.
- In the first term of stage one all students are assigned to tutorial groups of 3-5, which meet weekly with a member of staff. These may be used for help and encouragement with understanding material from lectures, for help with study skills, and for stimulation – 'treating them as mathematicians'.

- In the core stage one and two courses all students meet weekly in groups of 15-20, again with a member of staff. In these, students start problem sheets and are encouraged to discuss worksheets with each other.
- In all courses, coursework is returned to the student with feedback on his or her performance. This is valuable for students and lecturers alike.
- The Departmental Undergraduate Handbook gives comprehensive details about the Department, how it operates and all the programmes.
- In the first week of the first term an induction programme including study methods, information sources and the Departmental computing facilities. Other sessions are held at the start and end of every session, run by the Academic Coordinator, dealing with various aspects of the system.
- All staff are accessible through a dedicated office hours system.
- The Student-Staff Committee meets at least twice in terms 1 and 2 and once in term 3 to consider issues raised by students. In addition, the contributing departments have their own Student-Staff Committees, which are open to representation from Mathematics students.
- Detailed student handbook and course resources can direct students to sources of support at College level.
- Extensive supporting materials and learning resources in College libraries and computer centre.
- All Mathematics courses use Moodle as a vehicle for communication of information, learning resources and appropriate links.
- There is a dedicated Departmental computing laboratory.
- College Careers and Employability Service and Departmental Careers and Employability Tutor. Regular seminars on careers for mathematics students are held.
- Access to all College and University support services, including Student Counselling Service, Health Centre and the College Careers and Employability Service and Departmental Careers and Employability Tutor.
- Access to all College and University support services, including Student Counselling Service, Health Centre and the Disability and Dyslexia Services for students with disabilities and Specific Learning Difficulties.

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Admission requirements
The Department's standard conditional offer is available on the Course Finder web page. However, the Department also has considerable flexibility in its admissions and offers policy and strongly encourages applications from non-standard applicants. Students whose first language is not English may also be asked for a qualification in English Language at an appropriate level. For further guidance it may be helpful to contact the Recruitment and Partnerships Office.

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Further learning and career opportunities
Mathematics graduates are in high demand and have a wide range of employment prospects. Mathematicians are logical, numerate, have careful analytical skills and are confident in handling formulae or large data sets. These skills are in short supply in many key areas of industry, finance and government. Professional mathematicians are found in research teams working on problems as diverse as aircraft design, operational research or cryptography. Recent graduates have also started lucrative careers in finance, actuarial work, accountancy, and management. For further details please refer to the Careers Service.

Many graduates go on to further study (MSc or PhD) either within the Department or elsewhere. Because many subjects are taught by experts in their field, students have an excellent opportunity to progress onto postgraduate study. The Department has a thriving postgraduate research school and the internationally renowned Information Security Group. Together they offer MSc courses in Mathematics for Applications, Mathematics of Cryptography and Communications, and Information Security.

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Indicators of quality and standards
Royal Holloway's position as one of the UK's leading research-intensive institutions was confirmed by the results of

the most recent Research Excellence Framework (REF 2014) conducted by the Higher Education Funding Council (HEFCE). The scoring system for the REF 2014 measures research quality in four categories, with the top score of 4* indicating quality that is world-leading and of the highest standards in terms of originality, significance and rigour and 3* indicating research that is internationally excellent. 81% of the College's research profile was deemed to be within the 4* or 3* categories, an increase of over 20% since 2008. This results for the quality of our research outputs placed Royal Holloway 15th in the UK based on an overall Grade Point Average (GPA) score and 20th in the UK for 4* and 3* research. The Department of Mathematics is ranked 18 in the UK for research of 4* standard and 5 for 3* and 4* research and is ranked within the top 5 departments for their subject in the UK.

List of programmes

All the programmes are taught entirely by staff at Royal Holloway, University of London, and lead to awards of the University of London. The QAA subject benchmark statement in Mathematics, Statistics and Operational Research (revised June 2015) describes the general features which one might expect from Honours Degree programmes in the subject, and can therefore be used as a point of reference when reading this document (see www.qaa.ac.uk). UCAS codes are given in parentheses (see www.ucas.ac.uk). The following programmes are accredited by the Institute of Mathematics and its Applications to meet the requirements of the Chartered Mathematician designation when followed by subsequent training and experience in employment to obtain equivalent competences to those specified by the Quality Assurance Agency (QAA) for taught masters degrees: BSc Mathematics, BSc Mathematics with Statistics, BSc Mathematics with Philosophy, BSc Mathematics with Management, BSc Mathematics with Italian, BSc Mathematics with French, BSc Mathematics with Spanish, BSc Mathematics with German. The MSci Mathematics is accredited by the Institute to meet the educational requirements of the Chartered Mathematician designation: MSci Mathematics.

Single Honours Degree programmes & Combined Honours programmes taught wholly within Mathematics

- BSc Mathematics (G100)
- MSci Mathematics (G103)
- BSc Mathematics with Statistics (G1G3)
- BSc Mathematical Studies (G150)

Combined Honours Degree programmes with Mathematics as a major or minor component

- BSc Mathematics with Management (G1N2)
- BSc Mathematics with French (G1R1)
- BSc Mathematics with German (G1R2)
- BSc Mathematics with Italian (G1R3)
- BSc Mathematics with Spanish (G1R4)
- BSc Mathematics with Philosophy (G1V5)
- BA French with Mathematics (R1G1)
- BSc Management with Mathematics (N2G1)

Joint Honours Degree programmes with Mathematics as an equal component

- BSc Computer Science and Mathematics (GG41)
- BSc Economics and Mathematics (LG11)
- BSc Finance and Mathematics (NG31)
- BSc Mathematics and Management (GN12)
- BA Mathematics and Music (GW13)
- BSc Mathematics and Physics (GF13)
- MSci Mathematics and Physics (GFC3)