

Faculty of Science

1 GENERAL FACULTY REGULATIONS¹

Degrees

1 The faculty provides courses leading to the following degrees:

(a) MATHEMATICS²

Bachelor in Arts (Moderatorships in Mathematics, in Philosophy and Mathematics, and in Theoretical Physics (B.A. with honors)), Bachelor in Arts (Ordinary B.A. degree), see II below; Master in Science (M.Sc.) in High Performance Computing, see PART 2 OF THE CALENDAR — GRADUATE STUDIES AND HIGHER DEGREES.

(b) SCIENCE

Bachelor in Arts (Moderatorships in Science (in one of the following subjects: biochemistry with cell biology, biochemistry with immunology, biochemistry with structural biology, botany, chemistry, environmental sciences, genetics, geography, geology, microbiology, molecular medicine, neuroscience, physics, physics and astrophysics, physics and computer simulation, physiology, zoology), in Human Genetics, in Chemistry with Molecular Modelling, in Medicinal Chemistry, and in Physics and Chemistry of Advanced Materials (B.A. with honors)), Bachelor in Arts (Ordinary B.A. degree), see III below; Master in Science (M.Sc.) in Biodiversity and Conservation, in Chemical and Biological Techniques, in Environmental Sciences, see PART 2 OF THE CALENDAR — GRADUATE STUDIES AND HIGHER DEGREES.

The degrees of M.Sc. and Ph.D. may be awarded on the basis of research undertaken in any of the schools or departments of the faculty. For regulations see PART 2 OF THE CALENDAR — GRADUATE STUDIES AND HIGHER DEGREES.

Admission

2 Applications for admission from E.U. applicants to the courses for these degrees (except for higher degrees) should be made to the Central Applications Office (C.A.O.), Tower House, Eglinton Street, Galway. Applicants are referred to the C.A.O. handbook for details of application dates and procedures. Applications for admission from non-E.U. applicants should be made to the Office of International Student Affairs, Trinity College, Dublin 2 by 1 February of year of proposed entry.

3 Applicants must satisfy the admission requirements of the University, together with any special requirements for entry into particular courses in the faculty; see ADMISSION REQUIREMENTS.

Abridgement of courses

4 Students may be permitted to abridge their course by admission to the Senior Freshman or, in some cases, the Junior Sophister year if, in the opinion of the appropriate committee of the faculty, they are qualified by their knowledge and attainment to do so, and if places are available. Applications should be made to the Admissions Office on or before 1 June of the intended year of entry.

¹These regulations should be read in conjunction with GENERAL REGULATIONS AND INFORMATION.

²For details of courses in mathematics in combination with other subjects, see TWO-SUBJECT MODERATORSHIP COURSES.

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Academic progress

5 To rise with their class, students must (a) attend satisfactorily the lectures given in the subjects of their course each term as required by the University Council and the appropriate faculty committee, (b) perform satisfactorily the prescribed exercises (essay, tutorial or practical work), and (c) pass, in accordance with the regulations of their school or department, the prescribed examinations, see GENERAL REGULATIONS AND INFORMATION.

General examination and assessment information

6 Results for all examinations and assessments are published by grade with the grades corresponding to the percentage marks shown: I = 70-100, II₁ = 60-69, II₂ = 50-59, III = 40-49, F₁ = 30-39, F₂ = 0-29. In order to pass, a mark of at least 40 per cent is required.

Repetition of year

7 Students who in any year have failed to satisfy any one or more of the conditions defined in §5 will not, except as provided in GENERAL REGULATIONS AND INFORMATION, receive credit for the year. If they wish to proceed in their chosen course and if they are entitled to do so, they may apply through their tutor for permission to repeat the year. The appropriate committee may permit them to repeat the year or may exclude them from the course. In this case, they may apply for permission to transfer to an alternative course, either inside or outside the faculty.

Foundation scholarship

8 Students intending to present themselves for this examination should see FOUNDATION SCHOLARSHIPS.

Gold medals and prizes

9 Gold medals are awarded by the Board to candidates of the first class who have shown exceptional merit at the annual degree examination. For prizes in the faculty, see PRIZES AND OTHER AWARDS (see also MISCELLANEOUS AWARDS).

At the annual examinations a book prize (value €32) is awarded to each candidate obtaining an overall first class honors grade. These prizes are not awarded in the Senior Sophister year.

Book prizes must be claimed in the Examinations Office, West Theatre, by the award holder in person. These prizes are issued in the form of vouchers which can be exchanged by the students at designated booksellers.

II SCHOOL OF MATHEMATICS

1 The School of Mathematics offers a degree course in mathematics in which students can select, particularly in the Sophister years, combinations of courses chosen from various areas; these include pure mathematics, applied mathematics, theoretical physics, numerical analysis, computing and statistics.

2 The School of Mathematics in conjunction with the School of Physics offers a degree course in theoretical physics. This is an integrated programme of study consisting of lectures and tutorials in mathematics and physics together with experimental work in physics.

3 Mathematics may also be studied as a component of a two-subject moderatorship course in combination with one of several other subjects.

Fees

4 See COLLEGE CHARGES.

Rowe Fund Library

5 Members of the Dublin University Mathematical Society have the use of a mathematical library in the society's rooms in addition to the College library.

MODERATORSHIP IN MATHEMATICS

6 In the Junior Freshman year students take courses MA113, MA114, MA121, ST151 and MA161. In the Senior Freshman year students take courses MA114, MA214, MA216, MA221, MA224, MA231 and one course chosen from MA241, ST251 and CS2E3. Each of these courses is assessed by means of continuous assessment, term tests, and/or a paper set at the annual examination held in the weeks following the end of teaching in the Trinity term.

7 In the Junior Sophister year, students take courses providing 60 ECTS credits, with at most 10 ECTS credits deriving from courses at the group II level, the remainder deriving from courses at the group III level. In the Senior Sophister year, students take courses at the group III level providing 60 ECTS credits.

In all years students should make their choice of courses in accordance with the programme requirements published by the School of Mathematics before the commencement of the academic year. The director of teaching and learning (undergraduate) may permit programmes of study that are not expressly provided for in these published programme requirements, provided that the resulting choice of courses accords with the objectives of the moderatorship course. Certain combinations of courses may not be available due to timetabling constraints.

8 Results for examinations and assessments are published according to the following grades: I = 70-100, II₁ = 60-69, II₂ = 50-59, III = 40-49, F₁ = 30-39, F₂ = 0-29. In order to pass, a mark of at least 40 per cent is required.

To gain a pass in the examinations of the Freshman years, students must attain a mark of at least 35 per cent in each course, and must also attain an overall mark of at least 40 per cent. Junior and Senior Freshman students who do not qualify to proceed at the annual examination must take a supplemental examination, sitting papers set on each of the courses in which they have failed. These supplemental examinations are held at the beginning of Michaelmas term. There are no supplemental examinations in the Sophister years. To proceed to the Senior Sophister year, a student must pass in courses that together provide at least 40 ECTS credits, and must also achieve an overall average of at least 40 per cent at the Junior Sophister examination.

Junior Sophister students whose annual examination results average 40 per cent or more may be permitted to graduate with an ordinary degree if they do not choose, or are not qualified, to proceed into the Senior Sophister year. Students who are not qualified to proceed may apply to repeat their

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year in accordance with §10 below. Except by special permission of the University Council, the ordinary degree of B.A. may be conferred only on candidates who have spent at least three years in the University.

The examinations of the two Sophister years count equally towards the overall mark for moderatorship. Projects in the Senior Sophister year in course MA499 must be approved and undertaken in accordance with regulations established by the School of Mathematics, and these should be completed and submitted by the first day of Trinity teaching term.

Students who fail to reach moderatorship standard in their Senior Sophister year will be awarded an ordinary B.A. degree.

Mathematics and computing

9 Students with a strong interest in computing, but who wish to pursue this from a mathematical point of view may do so within the moderatorship course in mathematics, while at the same time studying mathematics to a high level. Such students should take course CS2E3 in the Senior Freshman year so as to satisfy the prerequisites for courses in the areas of microprocessor systems, systems software, compiler design, computer engineering and computer-aided design in the Sophister years. They may also take group III courses in mathematical topics directly related to computing in the Sophister years.

Repetition of year in mathematics

10 Students may apply for permission, or may be required, to repeat an academic year as provided under general College regulations. Students are not allowed to repeat a year if they have obtained an overall mark of 29 per cent or lower for the year.

MODERATORSHIP IN THEORETICAL PHYSICS

11 In the Junior Freshman year students take the full Junior Freshman physics course³ together with mathematics courses MA113, MA121 and MA141. In the Senior Freshman year students take the full Senior Freshman physics course³ together with MA214, MA216, MA224, MA231 and MA241. Each of these courses is assessed by means of continuous assessment, laboratory work, term tests, and/or a paper set at the annual examination held in the weeks following the end of teaching in the Trinity term.

12 In each Sophister year, students take group III mathematics courses that together provide 30 ECTS credits, chosen in accordance with the programme requirements published by the School of Mathematics before the commencement of the academic year, together with specified lecture courses and practical work in physics. In addition Senior Sophister students are required to do a computational project or to take further practical work in physics. Constraints may be imposed on the choice of courses, and the choice of mathematics courses is subject to the approval of the director of teaching and learning (undergraduate) for mathematics.

13 To gain a pass in the examinations of the Freshman years, students must pass in both mathematics and physics. The overall result for the year will be an appropriately weighted average of the grades in mathematics and physics.

Results for examinations and assessments are published according to the following grades: I = 70-100, II₁ = 60-69, II₂ = 50-59, III = 40-49, F₁ = 30-39, F₂ = 0-29. In order to pass, a mark of at least 40 per cent is required.

To gain a pass in mathematics in the examinations of the Freshman years, students must attain a mark of at least 35 per cent in each mathematics course, and must also attain an overall mathematics mark of at least 40 per cent. Junior and Senior Freshman students who have failed in mathematics at

³See COURSES IN SCIENCE, section III.

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the annual examination must take a supplemental examination in mathematics, sitting papers set on each of the mathematics courses in which they have failed; those who have failed in physics at the annual examination must take a supplemental examination in physics. These supplemental examinations are held at the beginning of Michaelmas term. There are no supplemental examinations in the Sophister years.

To qualify to proceed to moderatorship, Junior Sophister students sitting the examination for the first time must pass in mathematics and obtain at least 45 per cent in physics. Students sitting the Junior Sophister examinations for the second time must pass in mathematics and obtain at least a II₂ grade in physics to qualify to proceed to moderatorship. The overall result for the Junior Sophister year will be determined by the average of the marks for mathematics and physics. Junior Sophister students whose annual examination results average 40 per cent or more may be permitted to graduate with an ordinary degree or may apply to repeat their year in accordance with §14 below. Except by special permission of the University Council, the ordinary degree of B.A. may be conferred only on candidates who have spent at least three years in the University.

The mark for moderatorship is divided equally between mathematics and physics. The mathematics examinations of the two Sophister years count equally towards the overall mark for moderatorship. The Junior Sophister physics examination counts for 10 per cent of the overall mark for moderatorship. Students who fail to reach moderatorship standard in their Senior Sophister year will be awarded an ordinary B.A. degree.

Repetition of year in theoretical physics

14 Students may apply for permission, or may be required, to repeat an academic year as provided under general College regulations. Students are not allowed to repeat a year if they have obtained an overall mark of 34 per cent or lower for the year.

TWO-SUBJECT MODERATORSHIP COURSES

15 Students may combine mathematics with economics, philosophy, geography and a range of arts subjects in a two-subject moderatorship course. For details see TWO-SUBJECT MODERATORSHIP COURSES.

Transfer of course

16 Students may apply through their tutor to transfer from the honor course in theoretical physics to the honor course in mathematics not later than the end of the Junior Sophister year.

Sophister students in theoretical physics may apply through their tutor to transfer to the honor course in physics (see COURSES IN SCIENCE, section III), not later than the beginning of the Senior Sophister year.

Each request to transfer is considered by the heads of school concerned, who then make recommendations to the Senior Lecturer. All transfers are subject to general College regulations (see GENERAL REGULATIONS AND INFORMATION).

Courses

Group I

MA113	Linear algebra	(10 credits)
MA114	Groups and rings	(10 credits)
MA121	Analysis I	(20 credits)
MA141	Mechanics I	(10 credits)
ST151	Statistics I	(10 credits)
MA161	Computing I	(10 credits)

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MA214	Complex analysis	(5 credits)
MA216	Ordinary differential equations	(5 credits)
MA221	Analysis II	(10 credits)
MA224	Geometry	(10 credits)
MA231	Equations of mathematical physics	(10 credits)
MA241	Mechanics II	(10 credits)
ST251	Statistics II	(10 credits)
CS2E3	Computer science II	(5 credits)

Group III

In any given year, the group III courses available to students, and the constraints imposed on the choice of courses, are published by the School of Mathematics before the commencement of the academic year. The group III courses provided by the School of Mathematics will include a selection of courses from the following list (and may also include courses not listed here):

MA311	Abstract algebra	(10 credits)
MA321	Functional analysis	(10 credits)
MA322	Dynamical systems	(10 credits)
MA363	Algorithms	(10 credits)
MA371	Computation theory and logic	(10 credits)
MA373	Finite fields and coding theory	(10 credits)
MA374	Cryptography	(10 credits)
MA412	Measure theory and probability	(10 credits)
MA413	Partial differential equations I	(10 credits)
MA414	Complex analysis	(10 credits)
MA415	Topics in analysis	(10 credits)
MA416	Partial differential equations II	(10 credits)
MA417	Harmonic analysis	(10 credits)
MA418	Mathematical biology	(10 credits)
MA421	Algebraic topology	(10 credits)
MA424	Group representations	(10 credits)
MA425	Geometry and topology	(10 credits)
MA428	Topics in number theory	(10 credits)
MA432	Classical field theory	(10 credits)
MA433	Statistical mechanics	(10 credits)
MA441	Quantum mechanics	(10 credits)
MA442	Differential geometry and general relativity	(10 credits)
MA443	Statistical physics	(10 credits)
MA444	Quantum field theory	(10 credits)
MA445	Group theory and topology in physics	(10 credits)
MA446	Topics in statistical mechanics	(10 credits)
MA464	Numerical simulation of physical systems	(10 credits)
MA465	Numerical analysis	(10 credits)
MA471	Quantum computing	(10 credits)
MA481	Mathematical neuroscience	(10 credits)
MA499	Project	(10 credits)

Course CS2E3 (Computer science II) is a prerequisite for the following courses, provided by the Department of Computer Science:

CS3D1	Microprocessor systems	(5 credits)
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CS3D3	Concurrent systems (prerequisite: CS3D1)	(5 credits)
CS3D4	Computer aided design I	(5 credits)
CS4D2	Knowledge and data engineering	(10 credits)
CS4D4	Computer aided design II	(10 credits)

Course ST251 (Statistics II) is a prerequisite for the following courses, provided by the Department of Statistics:

ST370	Multivariate linear analysis and applied forecasting	(10 credits)
ST451	Applied linear statistical models	(10 credits)
ST452	Stochastic models in space and time	(10 credits)
ST453	Modern statistical methods	(10 credits)
ST454	Statistical inference	(10 credits)
ST463	Data mining	(10 credits)

The following group III course is provided by the Department of Economics:

MA381	Mathematical economics	(10 credits)
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III COURSES IN SCIENCE

REGULATIONS⁴

Fees

¹ See COLLEGE CHARGES.

MODERATORSHIP IN SCIENCE

² Courses are available in science leading to a moderatorship in one of the following subjects:⁵ biochemistry with cell biology, biochemistry with immunology, biochemistry with structural biology, botany, chemistry, environmental sciences, genetics, geography, geology, microbiology, molecular medicine, neuroscience, physics, physics and astrophysics, physics and computer simulation, physiology and zoology.

³ Theoretical physics, taught jointly by the Schools of Mathematics and Physics, is available as a separate moderatorship degree course. See SCHOOL OF MATHEMATICS, section II, §11.

⁴ Separate moderatorship courses are available in human genetics (see §§27-32 below), chemistry with molecular modelling (see §§33-36 below), medicinal chemistry (see §§42-46 below) and physics and chemistry of advanced materials (see §§47-51 below).

⁵ The Freshman courses are intended to provide both a training in general science and an introduction to the moderatorship subject. In the Junior Sophister year students will work primarily in the moderatorship subject but may take a selection of related courses offered by other schools or departments. All students wishing to proceed to moderatorship in any one of the subjects specified in §2 above are required to complete satisfactorily the Freshman courses in science except by decision of the Dean of the Faculty.⁶

The ECTS equivalent for each year of the course is as follows: Junior Freshman 60-70 credits; Senior Freshman 60 credits; Junior Sophister 60 credits; Senior Sophister 60 credits.

⁴These regulations should be read in conjunction with GENERAL FACULTY REGULATIONS and GENERAL REGULATIONS AND INFORMATION.

⁵For moderatorship in biochemistry with cell biology, biochemistry with immunology, biochemistry with structural biology, microbiology, molecular medicine, neuroscience and physiology for medical and dental students, see §10.

⁶See also section I, §4 'Abridgement of courses'.

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6 All students admitted are given an opportunity to discuss their choice of subjects with their tutor or the Dean of the Faculty and they are advised to visit their tutor before registration. Students may only proceed to the Sophister courses for which the Junior and Senior Freshman courses selected are an adequate preparation. Junior Freshman students wishing to change their combination of subjects must request the permission of the Dean of the Faculty, through their tutor, not later than the end of the third week of Michaelmas teaching term. Requests for transfers after this date will not be considered. In some subjects the number of places for Junior Freshman students may be limited so that it may not be possible to allow a student to transfer.

7 Junior Freshman students must give notice to the Dean of the Faculty, not later than the end of Trinity teaching term, of their choice of Senior Freshman subjects for the forthcoming year. Only in exceptional circumstances will the Dean of the Faculty consider requests for transfer from the subjects previously notified. No requests for transfer will be considered after 12 July.

8 Senior Freshman students must give notice to the Dean of the Faculty, not later than the end of Trinity teaching term, of their choice of Junior Sophister subject(s) for the forthcoming year. Requests for transfer from the subjects notified after this date will only be considered in exceptional circumstances and if the necessary places are available.

9 While every effort is made to allow students to study the course they choose the Dean of the Faculty of Science reserves the right to allocate the available places. In some courses the number of places for students of any one year may be limited. Timetable difficulties may also reduce the number of options available. Junior and Senior Freshman students who choose a subject combination that is not listed in the *Science Guide to subject choice handbook* or the *Choice of subject form*, must check the timetable for clashes. The onus is on the individual students to discuss their situation with the relevant schools or departments and, where possible, come to an arrangement whereby they will meet the requirements of the course being studied. In the event that the students do not come to a satisfactory arrangement with the head(s) of school(s) or department(s) concerned, they are required to select a subject combination that is listed on the *Choice of subject form* before the end of Trinity teaching term.

Moderatorship for dental and medical students

10 Dental or medical students who have completed their Junior Sophister year may apply to the Faculty of Science for permission to take a moderatorship in biochemistry with cell biology, biochemistry with immunology, biochemistry with structural biology, microbiology, molecular medicine, neuroscience or physiology. All applications must be made by the last day of Trinity teaching term. See SCHOOL OF DENTAL SCIENCE and SCHOOL OF MEDICINE.

Attendance and course work

11 Students must attend for appropriate academic instruction in each term of each academic year and must satisfy the head or heads of school or department concerned as to their academic progress in each term in order to proceed with their year; see GENERAL REGULATIONS AND INFORMATION. The faculty may from time to time draw up regulations determining the required attendance of students at the various forms of instruction.

Field courses

12 Students taking botany, environmental sciences, geography, geology or zoology are required to attend field courses.

The charges for field courses are in addition to the normal annual College fees. The charges vary from year to year and between the different departments. Students intending to take a subject requiring attendance at field courses will be informed by the head of department concerned regarding the courses planned and the costs involved.

TABLE I — PARAMETERS OF COURSE CHOICE

Junior Freshman year	Senior Freshman year	Junior and Senior Sophister years
<p>Students choose subjects from the following:</p> <p>Mathematics and two subjects from</p> <p>Biology Chemistry Geography/Geology¹⁰ Physics</p> <p><i>or</i></p> <p>Mathematical methods¹¹ and three subjects from</p> <p>Biology Chemistry Geography/Geology¹⁰ Foundation physics for the life and earth sciences</p>	<p>Three subjects are selected from the following:</p> <p>Biology I⁷ Biology II⁸ <i>or</i> Mathematics Chemistry Geography <i>or</i> Physics⁹ Geology</p> <p>N.B. Biology II cannot be taken with mathematics and geography cannot be taken with physics.</p> <p>Physics cannot be taken with biology II.</p> <p>The subject combination biology I, mathematics, physics cannot be taken.¹²</p>	<p>One subject is selected from the following:</p> <p>Biochemistry with cell biology Biochemistry with immunology Biochemistry with structural biology Botany Chemistry Environmental sciences Genetics Geography Geology Microbiology Molecular medicine Neuroscience Physics Physics and astrophysics Physics and computer simulation Physiology Zoology</p>

14 Each moderatorship subject requires the satisfactory completion of certain Junior Freshman and Senior Freshman subjects (see Table II). Timetabling constraints may also reduce the number of combinations available to students in the Freshman years. The specific combinations chosen by individual students will depend upon personal subject preference, moderatorship aspirations and school academic background (see also §17).

⁷A course in molecular and cellular biology (see p. O13).

⁸A course in organisms and the environment (see p. O13).

⁹Junior Freshman physics is a prerequisite for reading Senior Freshman physics.

¹⁰A single course providing an introduction to both geography and geology (see p. O13).

¹¹A short foundation course in mathematics and computing for Junior Freshman students not taking mathematics as a full subject (see p. O13).

¹²Subject combination biology I, mathematics and physics cannot be taken in the Senior Freshman year because of timetable constraints. Students wishing to take this combination must seek permission from the Dean of the Faculty before the end of Trinity teaching term. The onus is on the individual students to discuss the likelihood of studying this combination with the relevant school(s) or department(s) and, where possible, come to an arrangement whereby they will meet the requirements of the course being studied. In the event that the students do not come to a satisfactory arrangement with the school(s) or department(s) they are required to select a subject combination that is listed on the *Choice of subject form* and notify the Dean of the Faculty before the end of Trinity teaching term.

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TABLE II — MODERATORSHIP PREREQUISITES

Students are required to read at least three subjects in each of the Freshman years as set out in Table I above. Within this framework, Table II sets out the particular subject requirements for each moderatorship.

Junior Freshman prerequisites	Senior Freshman prerequisites	Moderatorship
Chemistry	Chemistry	Chemistry
Physics, Mathematics	Physics, Mathematics	Physics
Physics, Mathematics	Physics, Mathematics	Physics and astrophysics
Physics, Mathematics	Physics, Mathematics	Physics and computer simulation
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I	Biochemistry with cell biology
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I	Biochemistry with immunology
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I	Biochemistry with structural biology
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I	Genetics
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I	Microbiology
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I	Molecular medicine
Chemistry, Physics or Foundation physics for the life and earth sciences <i>or</i> Chemistry, Biology	Biology I, Biology II	Neuroscience
None	Biology I, Biology II	Physiology
Biology	Biology II	Botany
Biology	Biology II	Environmental sciences
Biology	Biology I, Biology II	Zoology
Geography/Geology	Geography	Geography
None	Geology	Geology

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16 After the publication of Senior Freshman examination results each year, all successful students are offered moderatorship places. Admission to each moderatorship may be limited by a quota established annually by reference to the teaching resources available to each school or department. Such admission is based on the average mark obtained in the Senior Freshman examinations in two subjects to include the prerequisite subject(s) as set out in Table II above and the order of choice as expressed by the student. To be qualified for a given moderatorship, students must have completed satisfactorily both Freshman years and must have read the stated prerequisite subjects as set out in Table II for any moderatorship for which they wish to be considered. Students who have not completed the prerequisites for a given moderatorship may still be considered for that moderatorship if places are available.

17 Advice on how to choose appropriate Freshman subject combinations for the various moderatorships is given in the document '*Guide to subject choice*' which may be obtained on request from the Science Faculty Office. Freshman course advisers in individual schools or departments may also be consulted.

Annual examinations

18 Annual examinations in all subjects are held at the end of Trinity term in the Junior Freshman, Senior Freshman and Junior Sophister years. Optional (group III) subjects taken by Junior Sophister science students outside a student's moderatorship subject may take place outside the annual examination period. Junior and Senior Freshman students who have failed in the Trinity term examinations must take a supplemental examination at the beginning of Michaelmas term. An expanded form of the following regulations giving further details of compensation requirements and other matters is available on request at the Science Faculty Office.

19 To gain a pass in the Junior Freshman examination, students must either pass in each subject or, in the case of the annual examination only, compensate for marks of 35-39 per cent in one subject by their level of performance in the others. To gain a pass in the Senior Freshman examination, students must pass in each subject. Students who do not qualify to rise with their year and whose overall average mark is 35 per cent or higher, either in the annual or the supplemental examination can, as provided under general College regulations, repeat their year in order to improve their performance.

20 To pass the Junior Sophister examinations students must achieve a mark of 40 per cent or higher in the examination of their group I and (where applicable) group II courses, and in the overall examination of their group I, group II and group III courses.

However, to qualify to proceed to moderatorship, students sitting the Junior Sophister examination for the first time must achieve a mark of 45 per cent or higher in the examination of their group I and (where applicable) group II courses, as well as in the overall examination of their group I, group II and group III courses; students sitting the Junior Sophister examination for the second time must achieve marks of 50 per cent or higher in the examination of their group I and (where applicable) group II courses as well as in the overall examination of their group I, group II and group III courses.

Students who achieve an overall mark of 35 per cent or higher, but who do not qualify to proceed to moderatorship, can, as provided under general College regulations, repeat the Junior Sophister year in order to improve their performance.

21 Students whose overall mark is 34 per cent or lower in their annual examinations and supplemental examinations (if applicable) are not permitted to repeat their year and must withdraw from science.

Moderatorship examination

22 The moderatorship examination is held in Trinity term of the Senior Sophister year. The examination is held on only one occasion annually. There are no supplemental examinations.

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Students unavoidably absent from the moderatorship examination may apply to the Senior Lecturer to present themselves for the moderatorship examination in the following year. If students are permitted by the Senior Lecturer to do so, without having to repeat the lectures, they must give notice at least three weeks before the end of Hilary teaching term.

23 If biochemistry with cell biology, biochemistry with immunology or biochemistry with structural biology is studied in the Senior Sophister year, 10 per cent of the total available marks in the moderatorship are awarded at the Junior Sophister examination. If chemistry, computational chemistry, chemistry with molecular modelling or medicinal chemistry is studied in the Senior Sophister year, 15 per cent of the total available marks in the moderatorship are awarded at the Junior Sophister examination. In the environmental science moderatorship, 16 per cent of the total available marks in the moderatorship are awarded at the Junior Sophister examination. If genetics or human genetics is studied in the Senior Sophister year, 10 per cent of the total available marks in the moderatorship are awarded on the basis of the Junior Sophister examinations. In the geography moderatorship, 20 per cent of the total available marks in the moderatorship are awarded at the Junior Sophister examination. If molecular medicine is studied in the Senior Sophister year, 10 per cent of the total available marks in the moderatorship are awarded at the Junior Sophister examination. If physics, physics and astrophysics or physics and computer simulation is studied in the Senior Sophister year, the marks awarded at the Junior Sophister examination count as 20 per cent of the total available marks in moderatorship. In the microbiology moderatorship, 10 per cent of the total available marks in the moderatorship are awarded at the Junior Sophister examination in microbiology.

24 Various forms of teaching and learning are a feature of the Senior Sophister programme and formal lectures will not necessarily be given in every term.

25 The scheme of distribution of marks between papers and practical work at the moderatorship examination will be published by individual schools or departments at the beginning of the Michaelmas term of the Senior Sophister year.

Ordinary degree of B.A.

26 Students who pass the Junior Sophister annual examinations may have the ordinary B.A. degree conferred if they do not choose, or are not allowed, to proceed to the Senior Sophister year. Except by special permission of the University Council, on the recommendation of the Dean of the Faculty, the ordinary degree of B.A. may be conferred only on candidates who have spent at least three years in the school or department concerned.

Courses

Junior Freshmen

BIOLOGY

The course is designed to provide students with a broad based training in the fundamentals of modern biology. It offers a comprehensive introduction to molecular and cellular biology; genetics; developmental biology; the biology of microorganisms; animal diversity; form and function of plants; and ecology. A practical skills programme supports the course throughout.

CHEMISTRY

The course provides a general introduction to the fundamentals of modern chemistry, and forms the basis for further studies, both in chemistry and in other sciences. It includes stoichiometry, atomic structure, principles of bonding, the periodic table, solid state, aspects of main group and coordination chemistry, gas laws, thermodynamics, solutions, equilibria, kinetics, electrochemistry, and aliphatic and aromatic functional group organic chemistry.

GEOGRAPHY/GEOLOGY

Students take the module 'Introduction to geography' which provides an entry to the broad discipline of geography. Topics covered include atmospheric and ocean systems, global climate change, geomorphology, economic geography, cultural geography, urbanisation and human-environmental interactions. Students are required to follow a programme of seminars. The course is examined through a combination of on-line assessments, seminar work and an examination paper taken at the end of Trinity term.

The geology course involves a series of lectures which explore the origin and evolution of the Earth and the organisms that live on it. Linked to the lectures are a series of tutorials and two half-day field trips which give 'hands-on' experience of rocks, minerals and fossils. Progress is assessed during the course by multiple choice theory tests and tutorial assignments.

MATHEMATICS

The course provides a basic mathematical training suitable for all branches of science. Topics covered include calculus; partial derivatives; linear algebra; introduction to differential equations; introduction to computing; introduction to probability and statistics; sample applications to scientific problems.

MATHEMATICAL METHODS

(For students not reading the mathematics course above)

This course consists of (a) an introduction to computing and (b) a foundation course in mathematics including the following topics: simple arithmetical and algebraic manipulations; functions; graphs; differentiation, emphasising its geometric interpretation; maxima and minima; integration; simple differential equations; matrices and linear equations.

PHYSICS

Physics is a foundation course of lectures, practical work and tutorials on mechanics, properties of matter, heat, waves, optics, electricity and magnetism, introductory astronomy, computational physics, and modern physics and may only be taken by students reading the mathematics course above. Students wishing to progress to a moderatorship in physics, physics and astronomy or physics and computer simulation must read physics and mathematics in the Junior Freshman year.

FOUNDATION PHYSICS FOR THE LIFE AND EARTH SCIENCES

Students reading the mathematical methods course above may read foundation physics for life and earth sciences. This is a foundation course of lectures, practical work and tutorials including the following topics: physics of motion, biomechanics, physics of hearing and seeing, electricity and magnetism and bioelectricity, radioactivity, nuclear physics and related medical applications, heat, pressure and fluids and their biological, geological and medical applications.

THEORETICAL PHYSICS

Students may study physics as a principal subject, with mathematics, in the moderatorship course in theoretical physics. (See SCHOOL OF MATHEMATICS, section II, §11.) The complete physics course is taken, together with most of the Junior Freshman moderatorship course in mathematics.

Senior Freshmen

BIOLOGY I — MOLECULAR AND CELLULAR BIOLOGY

Fundamentals of biochemistry; microbiology and immunology; molecular and microbial genetics; bioinformatics; neurobiology

BIOLOGY II — ORGANISMS AND THE ENVIRONMENT

Evolution; vertebrate form and function; plant diversity; applied plant science; ecology; behaviour

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CHEMISTRY

A broad-based course at intermediate level. In inorganic chemistry the chemistry of main group and transition metal elements and their compounds, and nuclear and medicinal inorganic species are considered. Courses in organic chemistry deal with the chemistry of aromatic compounds, stereochemistry, synthesis of organic compounds and organic spectroscopy. Physical chemistry topics covered are chemical thermodynamics and kinetics, basic quantum chemistry and spectroscopy, polymers and colloids. Lectures are complemented by laboratory work which includes synthetic organic chemistry, preparation and analysis of inorganic compounds and physical chemistry.

GEOGRAPHY

Building on issues raised in modules taught in the Junior Freshman year, topics covered at Senior Freshman level include more detailed investigations of cultural, economic and historical geography, and natural and human-modified environmental processes and systems.

Learning and research skills and an understanding of key concepts in geography are also developed in the Senior Freshman year through modules dealing with the collection and analysis of geographical information, including remotely sensed satellite data that are in digital form. Practical and fieldwork skills are also developed through compulsory field trips during the academic year.

GEOLOGY

The course includes lectures and practical work on Earth materials (elementary crystallography, polarised light microscopy, mineralogy, and petrography) and invertebrate palaeontology. It also includes the interpretation of geological maps, introductory geophysics, large-scale and small-scale geological structures, and Ireland's geology and geological resources. In addition, two half-day field excursions are held in the Dublin area, and a week-long field excursion is held at the end of Hilary term. This latter field course is a prerequisite for geology Sophister students.

MATHEMATICS

This course is a continuation of the Junior Freshman course in mathematics and includes advanced calculus; linear algebra; Fourier analysis; differential equations; introduction to partial differential equations; mechanics (for students of physics) or numerical computation and programming (for the other students); probability distributions; examples of scientific applications.

PHYSICS

The course is an extension of the Junior Freshman physics course and includes special relativity, oscillations, optics, current electricity, thermodynamics and nuclear physics, and a wide-ranging introduction to quantum physics, astronomy, computational physics together with practical work, tutorials and group study projects.

THEORETICAL PHYSICS

Students enrolled in the moderatorship course in theoretical physics take the full Senior Freshman physics course, together with a large part of the moderatorship course in mathematics. (See SCHOOL OF MATHEMATICS, section II.)

Sophister courses

Sophister courses in science are organised so that students follow a continuous programme of study over two years leading to a moderatorship in a particular subject. Students will be required to take courses equivalent to approximately sixty credits in each year. Courses will be divided into three groups:

- Group I — Obligatory courses in the moderatorship subject
- Group II — Alternative courses within the moderatorship subject
- Group III — Courses from other subjects

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Students may be required to, or may elect to take courses from group II and group III. A Sophister course programme is published annually and is available to students in Trinity term each year from the Faculty Office. This booklet provides a detailed schedule of all the courses available to Junior and Senior Sophister students, and includes information on the regulations governing group I, II and III courses.

Students are required to consult the adviser in their moderatorship subject when planning their course programme and are required to notify their course selection for the forthcoming year to the Faculty Office not later than 1 May in their Senior Freshman year.

BIOCHEMISTRY WITH CELL BIOLOGY

Biochemistry with cell biology is a new moderatorship course offered by the School of Biochemistry and Immunology. The emphasis in this course is on understanding how living cells perform their vital functions at both the cellular and molecular levels of organization. The course deals with both recent discoveries in biochemistry and cell biology and with the core material in these disciplines in order to provide the basis for understanding the mechanisms that make life possible. The Junior Sophister year consists of a varied programme of lectures, practicals, tutorials and a mini-review of the literature on a chosen topic. The new Senior Sophister programme is under constant revision and summaries of the specific content of each course in the programme are published annually. An extended research project in the area of cell biology and its biochemical basis forms an essential component of the course. The School of Biochemistry and Immunology has formed extensive links through the ERASMUS, TEMPUS and other European Union programmes which offer opportunities for students to spend a period of their course, usually in the third year, studying in a university in the United Kingdom, Western or Eastern Europe. Assistance and advice in future careers is also offered.

BIOCHEMISTRY WITH IMMUNOLOGY

Students interested in immunology can opt for a course that is taken through the School of Biochemistry and Immunology. Much of the content is shared with those taking biochemistry with cell biology and biochemistry with structural biology, but there are specialised courses in immunology in both Sophister years. The immunology courses in the Junior Sophister year are core concepts in immunology and disease (including bacterial, viral and parasitic diseases, autoimmune diseases, allergy and asthma, cancer and transplantation). In the Junior Sophister year there are also immunology practicals, tutorials and exercises, as well as some courses in microbiology. There is the option of a summer internship in research laboratories worldwide. In the Senior Sophister year, students carry out an immunology research project based in one of the independent research laboratories within the school. Lecture courses are updated regularly and summaries of specific course content are published annually. Lectures in immunology include viral evasion strategies, cytokine signalling, clinical immunology, neuroimmunology and innate and adaptive immunity in disease. Other courses covered include apoptosis, cancer and invasion, proteomics and cytoskeleton. The School of Biochemistry and Immunology has formed extensive links through the ERASMUS, TEMPUS and other European Union programmes which offer opportunities for students to spend a period of their course, usually in the third year, studying in a university in the United Kingdom, Western or Eastern Europe. Assistance and advice in future careers is also offered.

BIOCHEMISTRY WITH STRUCTURAL BIOLOGY

Biochemistry with structural biology is a new moderatorship course offered by the School of Biochemistry and Immunology. The emphasis in this course is on understanding how biological systems perform their vital functions at the molecular level, in scales ranging from cellular organelles to atomic resolution of proteins, DNA and RNA. The course will include current techniques in structural biology, and will draw expertise from the protein X-ray Crystallography Group as well as the newly established Molecular Design Group. The overall aim is to reveal how

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proteomics, bioinformatics and structural biology converge to provide a structural perspective on biological processes occurring in living cells. The Junior Sophister year consists of a varied programme of lectures, practicals, tutorials and a mini-review of the literature on a chosen topic. The new Senior Sophister programme is under constant revision and summaries of the specific content of each course in the programme are published annually. An extended research project based on structural approaches to biological problems forms an essential component of the course. The School of Biochemistry and Immunology has formed extensive links through the ERASMUS, TEMPUS and other European Union programmes which offer opportunities for students to spend a period of their course, usually in the third year, studying in a university in the United Kingdom, Western or Eastern Europe. Assistance and advice in future careers is also offered.

BOTANY

Teaching in botany is research led and focuses on the areas of ecology, systematics and conservation and whole plant physiology. Extensive use is made of the notable departmental herbarium and the College Botanic Garden. In every other year, subject to resources being available, one of the field courses will take place in the Mediterranean or tropical regions. The moderatorship course aims to produce graduates equipped with a range of subject-specific and transferable skills. The Sophister years use a mixture of lectures, tutorials, seminars given by visiting speakers and practical classes, including fieldwork, to deliver an integrated, up-to-date programme in plant biology. This includes, in the Senior Sophister year, the production of a dissertation based on a research project.

Junior Sophisters take courses in plant physiology, vascular plant diversity, plant taxonomy, identifying flowering plants, fundamentals of plant ecology, palaeoecology, plant anatomy, plant biochemistry, temperate plant communities, plant molecular biology, soils and data processing; as well as attending workshops and tutorials, at least two field courses and departmental seminars. There is a strong practical element in most of the courses. One Broad Curriculum course must be taken by all students and there may be an opportunity to take a limited number of Sophister courses offered by other schools or departments.

Senior Sophisters take courses in plant biodiversity, plant community analysis, environmental physiology of plants, plant molecular biology, pollination biology, plant conservation and data analysis; as well as attending workshops and tutorials, at least two field courses and departmental seminars. The research project is carried out under the supervision of one of the academic staff and accounts for approximately 30 per cent of the final year marks.

In most courses, practical notebooks and prescribed exercises form part of the assessment. The workshops and tutorials will be assessed by essays, small project reports, literature reviews, oral presentations and by answers in problem solving sessions.

CHEMISTRY

Junior Sophisters take courses in organic, inorganic, physical, environmental and medicinal chemistry covering topics such as organic mechanisms and synthetic methods, heterocyclics, natural products, amino acids and peptides, organic and inorganic polymers, group theory, spectroscopy and other physical methods, quantum chemistry and statistical mechanics, advanced thermodynamics, coordination chemistry, organometallics, catalysis and surface chemistry, electrochemistry, chemistry of the atmosphere, analytical chemistry, metal compounds in the environment, drug design and bio-organic chemistry. Lectures are complemented by practical classes in inorganic, organic, and physical chemistry; advanced preparative methods and instrumental techniques including computer controlled equipment are introduced.

In the Senior Sophister year the core courses take some of these subjects to a more advanced level, and also include homogeneous catalysis, physical organic chemistry, reaction dynamics, photochemistry and solid state chemistry. A wide range of optional courses is provided including interdisciplinary topics such as environmental chemistry and medicinal chemistry. A list of topics

available in any year can be provided by the school. The practical component in the Senior Sophister year is an extended research project during the Michaelmas term, which may be carried out in an advanced industrial laboratory or in an approved academic laboratory in another country. Students are also required to make presentations which may include one or more essays, written communications, seminars and posters during the year.

ENVIRONMENTAL SCIENCES

The course is intended for science students with particular interest in the environment. Courses in the Junior and Senior Sophister years will consist of lectures, seminars, practical laboratory and fieldwork in the broad areas of ecology, terrestrial and aquatic systems, environmental measurement, analytical techniques, animal and plant identification, environmental impact assessment, legislation, conservation, hydrology, water treatment, environmental aspects of geology and geography and geographical information systems. During the Senior Sophister year candidates must carry out research on a specific problem and prepare a dissertation which forms an essential component of the honors degree.

GENETICS

The teaching and research activities of the Genetics Department are in the areas of molecular, human, population and quantitative genetics and evolution. The Junior Sophister courses are designed to prepare for, and to introduce, advanced material from these and other related areas of genetics. Central genetics courses cover the basic processes of inheritance and gene expression, and genome structure and evolution, in man and other animals, plants, bacteria and viruses. The courses in molecular genetics depend heavily on the theory and techniques of genetic engineering while those in molecular evolution, population and quantitative genetics introduce students to computing and computer programming. There are courses on plant and animal breeding and on world problems of food resources and population. Students are required to take certain group III courses in microbiology and biochemistry. A field course is organised in Hilary term in co-operation with the student Genetical Society. The department arranges for Junior Sophister students to spend part of the long vacation working in genetics research laboratories abroad, usually in the United States.

The Senior Sophister programme allows students to choose courses relevant to their interests. All carry out a research project in association with one of the research groups in the department. There is a wide choice from molecular evolution, plant and animal breeding, human genetics and molecular genetics. The possible combinations and emphases are according to the aims of the students; the department believes that maximum realisation of aptitudes is primarily determined by motivation.

About 75 per cent of genetics graduates go on to study for higher degrees and careers in research. The course is designed so that a student who will not necessarily seek a research career will have attained experience in widely useful techniques which lead to interesting careers. For example those in molecular genetics would know many biochemical, bacterial, virological and genetic engineering techniques, while those in population or quantitative genetics would be competent computer programmers, familiar with a wide range of applied genetics as well as basic genetics. Students who specialise in human genetics will have particular knowledge of medical genetics, the genetic basis of cancer (oncogenetics), diagnostic genetics and genetic counselling.

GEOGRAPHY

Course work in the two Sophister years constitutes an integrated programme that builds on work covered in earlier years, the aim being to produce graduates who, while having a firm grounding in geography, are also equipped with a range of subject-specific and transferable skills. Students choose from a range of modules that may cover statistical applications; geographical information systems; regional studies; urban geography; comparative historical geography; the historical geography of Ireland; environmental conflicts; environmental change; the historical geomorphology of Ireland;

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coastal processes and management; hydrology; cold climate geomorphology; and coastal and estuarine ecology. The modules 'Introduction to research' and 'History and philosophy of geography' are compulsory. Choices in any particular year may be limited by the availability of staff and timetable constraints.

Students are required to carry out fieldwork during the Sophister years, and to attend one or more field courses. They must undertake a dissertation which is assessed as part of the final examination and is an important feature of the degree. A satisfactory research proposal must be devised during the Junior Sophister year and the completed dissertation is submitted early in the Hilary term of the Senior Sophister year. Opportunities exist for Junior Sophister students to spend all or part of the year in a European university under the ERASMUS scheme.

Assessment is by a combination of work carried out during the year and by end of year examinations held in May and June. Details of examinations in the Freshman and Sophister years are available from the department; methods and the breakdown of assessments vary from course to course. Modules are assessed through a variety of means, including essays, group and individual project work, on-line assessments, oral presentations and written examinations, subject to §21 under TWO-SUBJECT MODERATORSHIP COURSES.

GEOLOGY

The Junior Sophister programme consists of a range of compulsory courses involving lectures and practical work in the main branches of the geological sciences. Junior Sophister students attend at least two major field classes away from Dublin.

In the Senior Sophister year, students attend a set of core courses in geology and choose from a range of optional courses, some of which are provided by other schools or departments.

Senior Sophisters undertake an independent project which is the subject of a dissertation and also attend field classes.

Students wishing to read geology must attend the week-long field course in their Senior Freshman year.

MICROBIOLOGY

Microbiology is the branch of biological science which deals with microorganisms — bacteria, protozoa, fungi (moulds and yeasts), and viruses. In terms of basic molecular and cellular biology it is closely allied to, but distinct from genetics and biochemistry. Elements of these subjects are included in the microbiology course. The Freshman courses in biology include contributions from the Department of Microbiology as an introduction. The Junior and Senior Sophister courses comprise lectures, laboratory practical classes, tutorials, seminars and research essays in three broad areas of microbiology over two years – (i) microbial pathogenicity, (ii) molecular and cell biology, and (iii) applied and environmental microbiology. Junior Sophister students are also required to take additional courses in immunology and genetics. In the Senior Sophister year, the course is divided between three compulsory (core) topics under these headings and ten optional specialist topics from which students normally choose four. Topics covered in-depth include: prokaryotic and eukaryotic genome structure; regulation of gene expression in prokaryotes and eukaryotes; DNA and RNA structure; cell surface structure; interactions of bacterial, viral, protozoal and fungal pathogens with the host; virology and cancer; programmed cell death; rational design of antimicrobial drugs; vaccinology; clinical microbiology; applied aspects of microbiology, including biotechnology; current national and international legislation and standards relating to microbiology. Senior Sophister students also carry out a research project in one of the research groups of the department. A degree in microbiology provides a broad education in the area of molecular and cellular biology for a range of employment in hospital laboratories, public health laboratories, biochemical and pharmaceutical industries, food, dairy and brewing industries, scientific civil service, water industry, education, publishing, technical sales, services and marketing, and management.

MOLECULAR MEDICINE

Molecular medicine is a new course run jointly by the School of Biochemistry and Immunology and the School of Medicine. This course has been introduced to recognise the revolutionary advances in disease diagnosis, therapy and prevention brought about by bio-molecular research. In the Junior Sophister year the course introduces core aspects of biochemistry (protein chemistry, membrane and cell biology, eukaryotic gene structure and expression, immunology) and varied topics related to molecular medicine (stem cells and gene therapy, drug absorption and metabolism and clinical aspects of cancer and infection). In the Junior Sophister year there are also practicals, tutorials and a mini-review of the literature on a chosen topic. In the Senior Sophister year students will be required to choose a research project in either of the schools. Lectures in the Senior Sophister year are divided equally between St James's Hospital and the main campus. Topics include innate and adaptive immunity, immunodeficiency, autoimmunity and inflammation, neuroscience and endocrinology, microbial diseases, molecular haematology and oncology, diagnostics and therapeutics, cell cycle and cancer. Both the School of Biochemistry and Immunology and the School of Medicine have extensive links through the ERASMUS, TEMPUS and other European Union programmes which offer opportunities for students to spend a period of their course, usually in the third year, studying in a university in the United Kingdom, Western or Eastern Europe. Assistance and advice in future careers is also offered.

NEUROSCIENCE

Neuroscience is a discipline devoted to the scientific study of the nervous system in health and disease, and is at the interface between neurobiology and cognitive science. It includes study of the nature and functioning of the nervous system at all levels, from the molecules that make up individual nerve cells, to the complexities of how behaviour, thoughts and emotions are produced. Neuroscience is a multidisciplinary area of investigation that makes use of a variety of methods and investigations from a wide range of traditional disciplines. Consequently the Junior and Senior Sophister neuroscience programmes are comprised of relevant modules contributed by schools in the Faculties of Health Sciences, Science, and Social and Human Sciences. In addition to taking specialist courses in neuroscience, students will gain valuable experience in skills that are important for a general scientific training such as data handling, biostatistics, experimental design, computing, scientific writing, oral communication skills, and critical analysis of scientific papers. An important component of the Senior Sophister year is a major research project that will be carried out in one of the several neuroscience research groups across campus, including those contributing to the recently founded Trinity College Institute of Neuroscience. The research project will be preceded by a literature review and will lead to a dissertation. The goal of this degree programme is to provide students with a well-balanced and integrated knowledge of neuroscience, and to highlight the progress and intellectual challenges in this new discipline.

PHYSICS

The course will consist of lectures, practical work, tutorials and seminars in advanced physics. During the Junior Sophister year lecture courses in various aspects of electromagnetic theory and electronics, waves, lasers and quantum optics, classical and quantum mechanics and spectroscopy, statistical mechanics, astrophysics, solid state physics and nuclear physics will be presented. Practical work will involve set experiments of an advanced nature. The Junior Sophister year includes a course on communication skills and career development.

In the Senior Sophister year the course will include lectures and tutorials covering some of the basic topics in the Junior Sophister year but at a more advanced level. Practical work will be an extended research project during the Michaelmas term which may in some cases be carried out in an advanced industrial laboratory.

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PHYSICS AND ASTROPHYSICS

At the end of the Senior Freshman year, students may choose to take the physics and astrophysics course in their final two years. In each Sophister year, students enrolled in the physics and astrophysics moderatorship substitute astrophysics courses for 15 ECTS credits of the total physics courses taken by general physics students. The Junior Sophister year includes a course on communication skills and career development. Specialised courses build on the groundwork provided by both the general physics courses and the introductory astronomical lectures. Lecture topics covered include both practical modern detection techniques used across the electromagnetic spectrum as well as the theoretical background needed to interpret observations. Hands-on experience of research is provided through laboratory exercises in the Junior Sophister laboratory – both computer-based and also utilising optical and radio telescopes in the School of Physics. Students may undertake a physics or astrophysics project in the first term of the Senior Sophister year, which may involve travel to an observatory abroad.

Junior Sophister courses range over modern astronomical instrumentation and detection techniques; astronomical spectroscopy and its application to stellar classification and the derivation of physical quantities from space plasmas; stellar structure and evolution; galaxies and galactic evolution; and a practical introduction to general relativity and modern cosmology. In the Senior Sophister year astrophysics lectures cover more in-depth studies of the denizens of our solar system, its formation and that of extra-solar planetary systems; interstellar matter; galaxies; and modern developments in astronomy (e.g. “missing mass”/dark matter, black holes; energetic phenomena).

PHYSICS AND COMPUTER SIMULATION

Computer simulation methods have become standard tools in physics. They are complementary to traditional theoretical and experimental methods of investigation. There is a need for physical science graduates who are proficient in scientific computing, both for academic research and in industry. Students may take this course during their two Sophister years. The course will consist of core lectures in the mainstream physics course including topics in electromagnetic theory, waves, lasers and quantum optics, classical and quantum mechanics, atomic and molecular spectroscopy, statistical mechanics, solid state and nuclear physics and specialist lectures in computer simulation. These will include programming languages, topics in numerical methods and applications such as classical and quantum dynamics. Practical work in the Junior Sophister year will be conducted in both experimental and computational laboratories. The Junior Sophister year includes a course on communication skills and career development. In the Senior Sophister year practical work will be a project in computer simulation during Michaelmas term and lectures during Hilary term will consist of core lectures in the mainstream physics course and additional lectures on computer simulation.

THEORETICAL PHYSICS

In the Junior Sophister year students enrolled in the moderatorship course in theoretical physics (see SCHOOL OF MATHEMATICS, section II) take specified lecture courses and practical work in physics together with specified courses in mathematics. In the Senior Sophister year practical work in physics is not required, but students have the option of further practical work or a computational physics project.

PHYSIOLOGY

Physiology is the study of how cells work, how they co-operate in organs like the heart or brain and how the operation of these organs is integrated. The moderatorship course in physiology provides students with an in-depth understanding of mammalian body function from the molecular level to that of the whole organism, with especial emphasis on human physiology in health and disease.

To be eligible to enter the physiology programme, students must have successfully completed the Senior Freshman biology I and biology II courses, which provide an introduction to the nervous

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(brain and spinal cord), cardiovascular (blood circulation), respiratory (lungs), gastrointestinal (digestion), excretory (kidneys) and endocrine (hormones) systems. The Sophister years build on this introduction to provide a detailed functional understanding of cells and of organ systems, together with training in scientific methodology, experimental design, data analysis and resource skills. Areas of physiology which reflect major research interests of the department include cellular neuroscience and exercise physiology.

During the second half of the Senior Sophister year, each student undertakes an individual research project preceded by a literature survey and resulting in a written dissertation. These projects may be based within the department or with an associated research group within one of the affiliated teaching hospitals. Assessment in the Sophister programme is by a combination of in-course evaluation and formal examination. Final assessment at the end of the Senior Sophister year includes *viva voce* examination by an external examiner.

Further details of the Sophister course structure and research options and information on typical career opportunities for physiology graduates are available on the website (<http://www.tcd.ie/Physiology/>).

ZOOLOGY

The Department of Zoology offers Sophister students training in many areas of the biology of animal systems emphasising particularly those aspects that relate to ecology, conservation and wildlife biology, parasitology, neurobiology, developmental biology and behaviour. The Junior Sophister programme highlights the major concerns of modern zoology and introduces the student to microscopical, molecular biological and analytical techniques and computer-aided data handling procedures. The courses examine the relationship between the form and function of various animal groups, their cell biology, physiology, ecology, parasitology and behaviour. A course on data handling introduces students to modern analytical approaches. A practical course on molecular techniques covers the application of molecular biology to zoological research. Freshwater, marine and terrestrial fieldwork gives another opportunity to learn about the diagnostic features of various animals and their interactions with the environment. Elective (group II) courses cover marine and freshwater biology and wildlife management. The Junior Sophister examinations are held at the start of Trinity term, and are followed by field- and practical-oriented courses.

The Senior Sophister year is largely tutorial-taught. Senior Sophister students choose advanced courses from topics in medical and environmental zoology and can pursue personal interests by selecting a series of special subject tutorials from the fields of freshwater and marine zoology, wildlife biology, molecular neurobiology, developmental biology and parasitology. A research project is a significant part of the Senior Sophister programme.

MODERATORSHIP IN HUMAN GENETICS

27 The moderatorship course in human genetics (TR073) provides students with a strong foundation in biology, mathematics and chemistry, an introduction to major fields of genetics and specialised courses in human genetics.

28 The course differs from the moderatorship in genetics in the obligation to study a particular combination of courses in the four year programme and the concentration on human genetics. The degree is awarded under the regulations of the Faculty of Science. Students apply specifically to the course TR073 Human genetics on the C.A.O. form.

29 Human genetics is a rapidly growing discipline within the subject of genetics. The field has acquired a distinctive body of knowledge and theory and experimental procedures and is presenting major challenges in both research and teaching. It has been revolutionised by the techniques of recombinant DNA (genetic engineering, molecular cloning, RFLP mapping, microsatellite markers, polymerase chain reaction, transgenic animals, etc.), and the data emerging from the Human Genome Project. The subject has been stimulated by the explosion in knowledge of medical genetics,

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especially the molecular basis of many inherited disorders; the explanation of cancer as an acquired genetic disease; the study of molecular evolution (which is telling much about the evolution of man); the study of the history and geography of human genes (linking genetics, anthropology and linguistics), and of ancient DNA (linking genetics and archaeology); the application of DNA fingerprinting to forensic science, and decisions about suitability for employment and insurance (linking genetics to law and business). Substantial problems in ethics have been raised as a result of the studies in human genetics.

30 A tutorial programme in association with relevant College schools and departments and outside authorities where appropriate, extending over the Freshman years of the course, will introduce students to consideration of the philosophical, ethical, social and psychological issues arising from human genetics.

31 A student who has taken biology, chemistry and mathematics in the Freshman years in the main science course (TR071) may apply to transfer at the beginning of the Junior Sophister year to the course in human genetics (TR073). Conversely, a student of human genetics (TR073) may apply to transfer at the beginning of the Junior Sophister year to the TR071 course. Applicants will be assessed on the basis of their qualifications at entry, as well as on their academic record in College, and any transfer will be subject to the availability of places.

32 Students must meet the general requirements of the Faculty of Science in order to rise with their year.

Courses

Junior Freshmen

Biology, chemistry and mathematics

Senior Freshmen

Biology I (molecular biology), mathematics (introducing students to mathematical problems in biology) and chemistry

Junior Sophisters

Foundation courses on recombinant DNA, molecular evolution, population genetics, quantitative genetics, bioinformatics, computer programming for genetics, statistics, mutation, DNA replication, gene expression etc. plus a series of courses in other subjects (e.g. biochemistry and microbiology) related to genetics.

Senior Sophisters

Students take a set of courses in specific aspects of human genetics (e.g. genetics of neural development, neuropsychiatric genetics, cancer genetics, developmental genetics, human evolutionary genetics, genetics of transgenic animals and gene therapy, immunogenetics, genetic diversity, gene expression in higher organisms, prions), carry out a research project and write a review on topics in human genetics.

MODERATORSHIP IN CHEMISTRY WITH MOLECULAR MODELLING

33 The moderatorship course in chemistry with molecular modelling (TR074) replaces the moderatorship in computational chemistry or computational physics which accepted students into the Junior Freshman year up to October 2004 (see §§37-41 below). The moderatorship in chemistry with molecular modelling (TR074) allows students to obtain a core chemistry degree while specialising in the theoretical and applied aspects of molecular modelling from materials chemistry to computational drug design.

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34 The degree is awarded under the regulations of the Faculty of Science, and prospective students will normally apply specifically to the course TR074 Chemistry with molecular modelling on the C.A.O. form.

35 A student taking the main course in science (TR071) may apply to transfer at the beginning of the Junior Sophister year to the course in chemistry with molecular modelling (TR074). Conversely a student of chemistry with molecular modelling (TR074) may apply to transfer at the beginning of the Junior Sophister year to the science (TR071) course. Applications will be assessed on the basis of their qualifications at entry, as well as their academic record in College, and any transfer will be subject to the availability of places.

36 Students must meet the general requirements of the Faculty of Science in order to rise with their year.

Courses

Junior Freshmen

Chemistry, mathematics and *either* physics *or* biology

In addition, special tutorials will be given on molecular modelling.

Senior Freshmen

Chemistry, mathematics and *either* physics *or* biology I

In addition, there will be special molecular modelling tutorials and computational molecular modelling laboratories.

Junior Sophisters

The course will comprise the core of the chemistry course with specialist molecular modelling course and laboratory work. These latter elements will include topics such as computer programming, numerical methods (optimisation and molecular dynamics) and applications, including solid state chemistry and protein structure. In each case lectures will be accompanied by tutorials and molecular modelling practical classes.

Senior Sophisters

The core of the chemistry moderatorship course will be taken as well as specialist molecular modelling courses which will develop on topics introduced in the Junior Sophister year. These will include advanced courses in molecular dynamics and optimisation and applications including computational drug design and materials chemistry. The practical element of the Senior Sophister year is an extended research project during the Michaelmas term, which may be carried out within the School of Chemistry or in an industrial laboratory or an approved academic laboratory in another country. This project must be related to molecular modelling. Students are also required to make presentations which may include one or more essays, seminars and posters during the year.

MODERATORSHIP IN COMPUTATIONAL CHEMISTRY MODERATORSHIP IN COMPUTATIONAL PHYSICS

37 The moderatorship courses in computational chemistry and computational physics no longer accept new students; the last Junior Freshman entry was in October 2004. They have been replaced by the moderatorship in chemistry with molecular modelling (TR074) (direct entry) and the moderatorship in physics and computer simulation (TR071) (entry via science). The remainder of this section pertains to students already admitted into the former TR074 (Computational chemistry/ Computational physics) course.

38 This moderatorship allows students to specialise in scientific computing at an advanced level

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during their undergraduate careers while maintaining a strong grounding in theoretical and experimental knowledge of the fundamental physical sciences.

39 The courses differ from the moderatorship in chemistry and the moderatorship in physics in the obligation to study a particular combination of courses in the four-year programme, and in the study of specialist computational physical science courses in the Sophister years. The degree is awarded under the regulations of the Faculty of Science.

40 Computational methods have become standard tools in chemistry and physics and are complementary to the traditional methods of theory and experiment in physical science. Computer modelling now contributes an essential part of much of modern research in these disciplines, and there is a need in industry for physical science graduates who are also proficient in scientific computing.

41 Students must meet the general requirements of the Faculty of Science in order to rise with their year.

Courses

COMPUTATIONAL CHEMISTRY

Junior Sophisters

The course will comprise the core of the chemistry course, with laboratory work, and specialist scientific computing courses. These latter will include topics such as programming methods, numerical methods and the modelling of particle motion. In each case they will focus on physical chemical processes and will be complemented by extensive practical computing exercises.

Senior Sophisters

The core of the chemistry moderatorship course will be taken as well as specialist scientific computing courses which will develop the topics introduced in the Junior Sophister year. This will include further work on programming and numerical methods, molecular modelling, and advanced topics in molecular dynamics and Monte Carlo techniques. Students are required to complete a computational project.

COMPUTATIONAL PHYSICS

Senior Sophisters

The core of the physics course. Specialist scientific computing courses will develop the topics introduced in the Junior Sophister year: further work on programming methods and numerical methods, advanced techniques for the solution of partial differential equations and non-linear systems, and advanced topics in molecular dynamics, Monte Carlo techniques including the Metropolis algorithm, and Langevin dynamics. Students are required to complete a computational project.

MODERATORSHIP IN MEDICINAL CHEMISTRY

42 The moderatorship in medicinal chemistry (TR075) is especially attuned to the development of the creative talent needed by the major enterprise that is the modern pharmaceutical industry, which is one of the largest and fastest growing business sectors in the modern world. The medicinal chemistry degree provides a sound general grounding in chemistry but focuses on, and extends into, topics of relevance to the design, synthesis and biological evaluation of new medicinal compounds.

43 The degree is awarded under the regulations of the Faculty of Science, and prospective students will normally apply specifically to the course TR075 Medicinal chemistry on the C.A.O. form. In certain cases it may be possible for students to transfer from the TR071 science course, as detailed below.

Faculty of Science

44 A student taking the main chemistry course in science (TR071) may apply to transfer at the beginning of the Junior Sophister year to the course in medicinal chemistry (TR075). Conversely, a student of medicinal chemistry (TR075) may apply to transfer at the beginning of the Junior Sophister year to the TR071 course. Applicants will be assessed on the basis of their qualifications at entry, as well as on their academic record in College, and any transfer will be subject to the availability of places.

45 The medicinal chemistry course for the Freshman years will follow that of the TR071 chemistry course, although additional special sessions will be held for the medicinal chemistry group, involving an introduction to the ideas and techniques of medicinal chemistry. In the Sophister years there will be some courses common with the TR071 courses, students at this stage will study the more specialised aspects of medicinal chemistry.

46 Students must meet the general requirements of the Faculty of Science in order to rise with their year.

Courses

Junior Freshmen

Medicinal chemistry students will take the TR071 courses in chemistry, biology and mathematics. In addition, they will attend a programme of special medicinal chemistry tutorials.

Senior Freshmen

Medicinal chemistry students will take the TR071 courses in chemistry, biology I and biology II or, alternatively, in chemistry, biology I and mathematics. In addition, they will participate in a medicinal chemistry research and presentation exercise.

Junior Sophisters

Medicinal chemistry students will share organic chemistry courses with TR071 students, and will also share some relevant inorganic and physical chemistry courses. In addition, they will take courses on the principles of medicinal chemistry, pharmacology, microbiology, biochemistry and industrial chemistry. Practical work will cover synthetic organic, inorganic, computational and physical chemistry.

Senior Sophisters

Medicinal chemistry students will take prescribed organic chemistry units in conjunction with TR071 chemistry Senior Sophister students. In addition, they will take specialised courses in the cardiovascular systems and the central nervous system, computational medicinal chemistry, case studies in AIDS, non steroidal anti-inflammatory drugs, anti-ulcer and asthma therapy, site-specific drug delivery, combinatorial chemistry and analytical methods. Practical work will consist of a research project, which will be undertaken during Michaelmas term. This will be carried out either in the School of Chemistry in Trinity College, under the supervision of a member of staff, or alternatively may be carried out in a university chemistry department overseas, or in the laboratories of an industrial concern.

MODERATORSHIP IN PHYSICS AND CHEMISTRY OF ADVANCED MATERIALS

47 The moderatorship course in physics and chemistry of advanced materials (TR076) allows students to specialise in materials science at an advanced level during their undergraduate careers due to the combination of courses offered by the Schools of Physics and Chemistry.

48 The course shares some lectures with those given for the moderatorships in chemistry and physics, and also provides a range of specialist advanced materials courses with a specifically tailored practical course. The degree is awarded under the regulations of the Faculty of Science.

Faculty of Science

Students apply specifically to the course TR076 Physics and chemistry of advanced materials on the C.A.O. form.

49 Our modern technological revolution has been firmly based on the development of advanced functional materials. Our computing power is based on silicon, crystals produce the laser light which carries information for telecommunications, and polymers, some of which conduct electricity, are ubiquitous. The knowledge of how to make, develop, control and use these advanced materials requires a thorough understanding of both chemistry and physics. The interdisciplinary nature of the moderatorship in the physics and chemistry of advanced materials gives graduates a broadly based scientific education that is vital for careers in the information technology sector as well as an excellent starting point for higher degrees in materials research.

50 A student who has taken mathematics, chemistry and physics in the Freshman years in science (TR071) may apply to transfer to the course in the physics and chemistry of advanced materials (TR076). Conversely, a student on the course in the physics and chemistry of advanced materials (TR076) may apply to transfer to the TR071 course. Applicants will be assessed on the basis of their qualifications at entry, as well as on their academic record in College, and any transfer will be subject to the availability of places.

51 Students must meet the general requirements of the Faculty of Science in order to rise with their year.

Courses

Junior Freshmen

Chemistry, mathematics and physics

Senior Freshmen

Chemistry, mathematics and physics

Junior Sophisters

The course in the Junior Sophister year includes lectures on solid state physics and chemistry, quantum mechanics, lasers, thermodynamics, electrochemistry, macromolecules, spectroscopy, group theory, materials preparation and microelectronic technology. The practical course in the Junior Sophister year introduces students to a wide range of characterisation methods and investigative techniques.

Senior Sophisters

The Senior Sophister course concentrates on specific topics, including more advanced solid state physics and chemistry, non-linear optics, materials for electronic and optoelectronic devices, conducting and insulating polymers and metal oxides, superconductivity, surface and interface effects, computer simulation and advanced growth techniques. The practical component of the Senior Sophister year is an extended research project during the Michaelmas term frequently carried out in an advanced industrial laboratory.