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Course Regulations for Year 1

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1)

To create a printable version of this section of the Handbook click on the "pages to go" link at the bottom right.

MATHEMATICS BSC. G100, MASTER OF MATHEMATICS MMATH G103, MATHEMATICS WITH BUSINESS STUDIES G1NC.

Normal Load = 120 CATS. Maximum Load = 150 CATS.

Students must take the 8 core modules (total 90 CATS), plus options. List A modules have a high mathematical content. The Core modules are: MA106 Linear Algebra, MA131 Analysis, MA132 Foundations, MA133 Differential Equations, MA134 Geometry and Motion, MA136 Introduction to Abstract Algebra, MA124 Maths by Computer, ST111 Probability A.

MATHEMATICS AND ECONOMICS GL11

The first year is in common with the BSc Mathematics degree course G100, with the addition of EC107 Economics I and ST112 Probability B as additional core modules (total core of 126 CATS).

Note. The Mathematics Department does not make first year List A modules compulsory, in order to give students (including those on joint degree courses) freedom of choice in building their options. However, the List A modules are important for many subsequent pure and applied maths modules, and we recommend that first year students take as many as possible to maintain flexibility for future maths modules. Choosing options is discussed here, and the first year List A options are discussed below.

Of the core, the modules MA131 Analysis, MA133 Differential Equations, MA106 Linear ALgebra and MA134 Geometry and Motion are designated as being "required cores". This means that all first years **must** pass these modules (at 40%) either in the Summer exams or the resit exams the following September, in order to progress in to the second year.

GL11 students must in addition pass EC107.

Additional advice to first year students

Maths Modules

hide

Term	Code	Module	CATS	List
Term 1	MA132	Foundations	12	Core
	MA133	Differential Equations	12	Core
	MA125	Introduction to Geometry	6	List A
	MA136	Introduction to Abstract Algebra	6	Core
Term 1 & 2	MA131	Analysis I and II	24	Core
Term 2	MA106	Linear Algebra	12	Core
	MA124	Maths by Computer	6	Core
	MA134	Geometry and Motion	12	Core
	MA117	Programming for Scientists	12	List B
Term 3	MA112	Experimental Maths	6	List A

Maths Modules for External Students

These modules are not available to Maths students.

hide

Term	Code	Module	CATS
Term 1	MA138	Sets and Numbers	12
Term 1 & 2	MA137	Mathematical Analysis I and II	24
Term 2	MA113	Differential Equations A	6

Statistics Modules

First year mathematics students interested in transferring to MORSE (Mathematics, Operational Research, Statistics and Economics) should include the following modules among their options

EC106 Introduction to Quantitative Economics(24 CATS, Terms 1-2);
IB104 Mathematical Programming I (12 CATS version, Term 3);
ST112 Probability B (6 CATS, Term 2)
ST104 Statisitcal Laboratory I (12 CATS, Terms 2-3)

This would allow transfer into the second year of MORSE, which consists of roughly equal proportions from the four participating departments (Statistics, Economics, Business Studies and Mathematics). Further details of MORSE can be obtained from the Statistics Department.

For transfer into Mathematics and Statistics students should take

ST112 Probability B (6 CATS, Term 2)
ST104 Statisitcal Laboratory I (12 CATS, Terms 2-3)

Transfer into any Statistics course will depend on available capacity and is likely to be restricted to only the strongest students.

Both Probability A (core) and Probability B are also essential for any further Statistics options in later years.

hide

Term	Code	Module	CATS	List
Terms 2 and 3	ST104	ST104 Statistical Laboratory I	12	List B
Term 2	ST111	Probability A	6	Core

	ST112	Probability B	6	List A Core (GL11)

Economics Modules

Mathematics & Economics (GL11) students should refer to the Economics Undergraduate handbook and to the section on joint degree courses in this handbook.

Other mathematics students (G100 or G103, BSc or MMath) may take EC106 Introduction to Qualitative Economics as an option. [Note: Maths & Economics students do NOT take EC106.] It is designed to be suitable for Mathematics students, and a good performance in this module >55% is a prerequisite for some optional second and third year Economics modules. See the Economics Department Undergraduate handbook, which also contains details of other more specialized first year economics options.

hide

Term	Code	Module	CATS	List
Terms 1 & 2	EC106	Introduction to Quantitative Economics	24	List B (not GL11)
	EC107	Economics I	30	Core (GL11 only)

Computer Science

Mathematics students should note that *at least one 1st year programming module*, or the ability to program in a high level language, *is a prerequisite* for most Computer Science modules in Years 2 and 3. There are two roughly equivalent high level programming modules. CS118 Programming for Computer Scientists which is taken by Computer Science students, and MA117 Programming for Scientists which is available to all Mathematics students as an option. MA117 satisfies the programming prerequisite for Computer Science options.

Students considering transferring to the Discrete Mathematics G4G1 degree should take the modules Discrete Mathhematics & its Applications 2 as well as MA117 Programming for Scientists.

hide

Term	Code	Module	CATS	List
Term 2	CS126	Design of Information Structures	15	List B
	CS137	Discrete Mathematics & its Applications 2	12	List B

Physics

Physics options for Mathematics students: Weekly problem sheets are issued for all the first year Physics modules. Any combination of Physics options may be taken. However, the Physics Department recommends the following modules and combinations, especially for students who may wish to transfer to the Maths and Physics degree at the end of the first year.

- PX101 Quantum Phenomena. This module deals from first principles with one of the major components of modern Physics. It leads on to several options in 2nd year Physics (see the second year options for details).
- PX148 Classical Mechanics and Special Relativity
- PX120 Electricity and Magnetism. These lectures treat the classical description of the behaviour of particles, waves and matter.

hide

Term	Code	Module	CATS	List
Term 1	PX148	Classical Mechanics and Special Relativity	12	List B
Term 2	PX120	Electricity and Magnetism	12	List B
	PX144	Introduction to Astronomy	6	List B
	PX147	Introduction to Particle Physics	6	List B
Term 3	PX101	Quantum Phenomena	6	List B

Philosophy Modules

Students wishing to follow modules in Philosophy should register for these modules at the start of Term 1, using the online registration system.

In order to follow 2nd or 3rd year Philosophy honours modules students must normally first have completed a total of 30 CATS of Philosophy modules at the first year level. Those in doubt should consult the module tutor of the relevant module.

Students on the Mathematics and Philosophy joint degree take the following two modules in their first year: PH142 Central Themes in Philosophy (term 2); PH136 Logic I: Introduction to Symbolic Logic (term 2). Mathematics students are also eligible for a transfer to Mathematics and Philosophy if they take the same module combination in their first year. See the Philosophy Department's website hide

Term	Code	Module	CATS	List
Term 1	PH144	Mind and Reality	15	List B
Term 2	PH136	Logic I: Introduction to Symbolic Logic	15	List B
	PH142	Central Themes in Philosophy	15	List B

Warwick Business School

Information for all WBS modules can be found here.

hide

Term	Code	Module	CATS	List
Term 3	IB104	Mathematical Programming I	12	List B

Languages

The Language Centre offers academic modules in Arabic, Chinese, French, German, Japanese, Russian and Spanish at a wide range of levels. These modules are available for exam credit as unusual options to mathematicians in all years. Pick up a leaflet listing the modules from the Language Centre, on the ground floor of the Humanities Building by the Central Library. Full descriptions are available on request. Note that you may only take one language module (as an Unusual Option) for credit in each year. Language modules are available as whole year modules, or smaller term long modules; both options are available to maths students. These modules may carry 24 (12) or 30 (15) CATS and that is the credit you get. We used to restrict maths students to 24 (12) if there was a choice, but we no longer do this.

Plan ahead! Note that 3rd and 4th year students cannot take beginners level (level 1) Language modules.

There is also an extensive and very popular programme of lifelong learning language classes provided by the centre to the local community, with discounted fees for Warwick students. Enrolment is from 9am on Wednesday of week 1. These classes do not count as credit towards your degree.

The Language Centre also offers audiovisual and computer self-access facilities, with appropriate material for individual study at various levels in Arabic, Chinese, Dutch, English, French, German, Greek, Italian, Portuguese, Russian and Spanish. (This kind of study may improve your mind, but it does not count for exam credit.)

Important note for students who pre-register for Language Centre modules

It is essential that you confirm your module pre-registration by coming to the Language Centre as soon as you can during week one of the new academic year. If you do not confirm your registration, your place on the module cannot be guaranteed. If you decide, during the summer, NOT to study a language module and to change your registration details, please have the courtesy to inform the Language Centre of the amendment.

Information on modules can be found at

http://www2.warwick.ac.uk/fac/arts/languagecentre/academic/

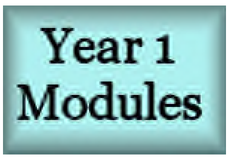
Engineering

Mathematics students interested in taking Engineering modules in later years should see the page for year 2 and 3 modules for any prerequisites. Details of all engineering modules can be found on the Engineering web pages.

Objectives

After completing the first year students will have

- made the transition in learning style and pace from school to university mathematics;
- been introduced to the basic concepts in university mathematics, in particular proof, rigour and calculations;
- begun the study of the foundational core;
- acquired knowledge, understanding and techniques necessary to proceed to the second year.



Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

General Advice to First Year Students

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/yr1advice)
As described in the "General" section, first-year Mathematics students get regular supervisions in groups in Terms 1 and 2, and the first 6 weeks of Term 3, in groups (normally of five) which are assigned at the start of the year. Personal tutors are available to answer questions about the course, individual modules, or anything else within reason.

Your A level background. There are many different A level syllabuses, with wide variations from one exam board to another, and from one selection of modules to another; in addition, not all schools teach the entire syllabus. Thus, some students may have missed out on some material which is needed for degree work, or may only have covered some topics skimpily and without adequate practice.

For the success of your career at Warwick, it is most important that you know these topics inside out, and are able to work with them fluently, confidently, and rapidly, even in the new and sometimes unexpected contexts of university maths. In the middle of a complicated argument, a lecturer may well simply assume that you can handle this kind of stuff easily and transparently, and lack of this ability may be a serious impediment to getting the most out of the course. Before you arrive you should have attempted the "Diagnostic Tests" on this material which will help both you to identify your strengths and weaknesses.

Tutorials. Every student has a personal tutor, with whom they will (where possible) remain throughout their degree. Tutors usually see their first-year students in groups of five once every two weeks, though students can see their tutors individually, in principle, as often as they want. The aim of the regular meetings is to find out how the students are getting on, and to provide extra help where needed. At the start of the year, your tutor can also help you to choose your optional modules.

The relationship between student and tutor is an important one. Your tutor is there to help you not only with mathematical difficulties, but also with other problems that may arise: difficulties in settling down to a steady programme of study, noisy neighbours in the Halls of Residence, how to catch up after an absence through illness, etc. etc. He or she also plays an important role after examinations at the end of each year. For example, if your marks are lower than they should be because you were unwell during your exams, your tutor can argue that you should not be obliged to repeat an exam, or even, in your final year, that the class of degree you are awarded should be higher than the marks suggest. Of course, this can only happen if he or she knows you and has a good idea of your ability. See also the section on Mitigation.

First year Core and List A options

The Warwick course regulations and our options scheme is listed elsewhere, but the 8 core modules (shared by all students in the Mathematics Department) add up to 90 CATS:

Core

MA106 Linear Algebra	12 CATS
MA133 Differential Equations	12 CATS
MA124 Mathematics by Computer	6 CATS
MA134 Geometry and Motion	12 CATS

MA132 Foundations	12 CATS
MA136 Introduction to Abstract Algebra	6 CATS
MA131 Analysis	24 CATS
ST111 Probability A	6 CATS

List A

MA112 Experimental Mathematics	6 CATS
MA125 Introduction to Geometry	6 CATS
ST112 Probability B	6 CATS

We recommend students to take as many of the List A options as possible, for the sake of flexibility with maths modules in future years. ST112 Probability B is a prerequisite for most second and third year Statistics options, and is either a prerequisite or recommended for many courses in Economics and Business Studies. Students on joint degree courses have additional core modules.

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

MA106 Linear Algebra

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma106)
Lecturer:
For students based in the Mathematics Department: Dr. Diane Maclagan

For students based in Physics, Statistics, Computer Science or other Departments: Damiano Testa

Term(s): Term 2

Status for Mathematics students: Core for Maths

Commitment: 30 one-hour lectures

Assessment: 15% from weekly assignments, 85% from a 2 hour examination

Prerequisites:

Leads To: Mainly 2nd year algebra modules, but results and techniques from linear algebra may be used in any higher year maths modules and even in some outside options.

Content: Many problems in maths and science are solved by reduction to a system of simultaneous linear equations in a number of variables. Even for problems which cannot be solved in this way, it is often possible to obtain an approximate solution by solving a system of simultaneous linear equations, giving the "best possible linear approximation".

The branch of maths treating simultaneous linear equations is called linear algebra. The module contains a theoretical algebraic core, whose main idea is that of a vector space and of a linear map from one vector space to another. It discusses the concepts of a basis in a vector space, the dimension of a vector space, the image and kernel of a linear map, the rank and nullity of a linear map, and the representation of a linear map by means of a matrix.

These theoretical ideas have many applications, which will be discussed in the module. These applications include:

1. Solutions of simultaneous linear equations.
2. Properties of vectors.
3. Properties of matrices, such as rank, row reduction, eigenvalues and eigenvectors.
4. Properties of determinants and ways of calculating them.

Aims: To provide a working understanding of matrices and vector spaces for later modules to build on and to teach students practical techniques and algorithms for fundamental matrix operations and solving linear equations.

Objectives: Students must understand the ideas of linearly independent vectors, spanning sets and bases of vector spaces. They must also understand the equivalence of linear maps between vector spaces and matrices and be able to row reduce a matrix, compute its rank and solve systems of linear equations. The definition of a determinant in all dimensions will be given in detail, together with applications and techniques for calculating determinants. Students must know the definition of the eigenvalues and eigenvectors of a linear map or matrix, and know how to calculate them.

Books:

David Towers, *Guide to Linear Algebra*, Macmillan 1988.

Howard Anton, *Elementary Linear Algebra*, John Wiley and Sons, 1994.

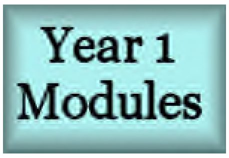
Paul Halmos, *Linear Algebra Problem Book*, MAA, 1995.

G Strang, *Linear Algebra and its Applications*, 3rd ed, Harcourt Brace, 1988.

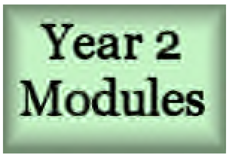
Recommended Syllabus

Additional Resources

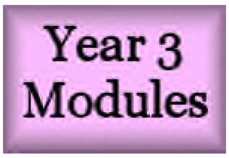
Archived Pages: Pre-2011 2011 2012 2013 2014 2015 2016 2017



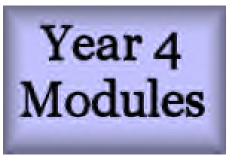
Year 1 regs and modules
G100 G103 GL11 G1NC



Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103



Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

MA112 Experimental Maths

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma112)
Lecturers: Andrew Brendon-Penn and Mark Cummings

Term(s): Term 3

Status for Mathematics students: List A for Maths

Commitment: One 3 hour lab session per week for 4 weeks (during weeks 1-5 of term 3)

Assessment: 100% by written reports on each of the projects

Prerequisites: Most core 1st year mathematics modules, especially MA133 Differential Equations, MA131 Analysis, MA136 Abstract Algebra, MA124 Maths by Computer, and MA134 Geometry & Motion.

Leads To: MA231 Vector Analysis, MA209 Variational Principles, MA250 Partial Differential Equations, MA3J3 Bifurcation, Catastrophes and Symmetry

Content:
This module consists of a series of 4 laboratory projects which combine physical or computer experiments with mathematical modelling and analysis. The projects will include work on symmetry breaking, catastrophe theory, nonlinear oscillators, period doubling, and coupled pendula.

Much more information is provided on the Additional Resources page, linked below. Due to deregistration dates being before the start of the module, we strongly advise all students who are seriously considering taking the module to read this.

Aims:
To demonstrate that mathematical ideas and techniques can be used to predict and explain `real life' phenomena and that, conversely, physical intuition can lead to mathematical insights.

Objectives:

1. To show how various aspects of mathematics seen in earlier modules can be applied to real-world situations, such as the application of differential equations to the study of coupled and nonlinear oscillators.
2. To illustrate the use of simple group theoretical ideas in problems with symmetries.
3. To provide an opportunity for students to learn the thought process used to solve long and complicated problems, by breaking them down into smaller, more manageable pieces.
4. To provide an opportunity for students to develop report writing skills.
5. To provide an opportunity for students to develop the ability to work in groups.

Books:
As this module follows on from several core first year modules, you are recommended to check the recommended texts for those modules.

Additional Resources

Archived Pages: 2012 2014 2015

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

MA117 Programming for Scientists

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma117)
Lecturer: Adam Chester

Term(s): Term 2

Status for Mathematics students: List B for Maths

Commitment: 10 lectures plus lab sessions/tutorials

Assessment: Three programming assignments.

Prerequisites: No previous computing experience will be assumed, but students should have obtained a code to use the IT Services work area systems prior to this module. Information and assistance is available in the Student Computer Centre in the Library Road.

Leads To: MA228 Numerical Analysis and modules given by the Computer Science Department that are based upon the Java language.

Content: Aspects of software specification, design, implementation and testing will be introduced in the context of the Java language. The description of basic elements of Java will include data types, expressions, assignment and compound, alternative and repetitive statements. Program structuring and object oriented development will be introduced and illustrated in terms of Java's method, class and interface. This will enable the development of software that reads data in a variety of contexts, performs computations on that data and displays results in text and graphical form. Examples of iterative and recursive algorithms will be given. The importance of Java and Java Virtual Machine in networked computing will be described. The majority of examples will be standard applications but the development of Java Applets to be delivered by web browsers will also be covered.

Aims: To provide an understanding of the process of scientific software development and an appreciation of the importance of data vetting, sound algorithms and informative presentation of results.

Objectives: To enable the student to become confident in the use of the Java language for scientific programming.

Books:

Books are not essential for this module as use will be made of on-line tutorial and reference material. An informative, optional text is

H M Deitel & P J Deitel, *Java How to Program* (2nd or 3rd Ed), Prentice Hall.

Additional Resources

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

MA124 Maths by Computer

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma124)
Lecturer: Grafke

Term(s): Term 2

Status for Mathematics students: Core for Maths

Commitment: One lecture per week with one 1-hour help class per week.

Assessment: The material learnt in the contact sessions will be assessed through five assignments, counting for 100% of the total mark.

Prerequisites: Knowledge of material from core first year maths modules will be assumed.

Leads To: By the end of the module you will find the computer to be a tool that can aid you throughout your life as a mathematician and, in particular, in many modules you will take at Warwick. Specific modules which might use Matlab include MA248 Applied Analysis, MA228 Numerical Analysis, MA398 Numerical Linear Algebra, MA3G0 Control Theory and MA496 Signal Processing. But you should think of your computing skills as a powerful resource to be used, potentially, at any time.

Aims: The first aim is to show how the computer may be used, throughout all of mathematics, to enhance understanding, make preditions, test hypotheses. This will be achieved primarily through eight hours of computer-based contact sessions.

Objectives: The module will be taught using the Matlab software package. Through using this software tool you will be introduced to the rudiments of computer programming.

You will learn how to graph functions, study vectors and matrices graphically and numerically, how to iterate and use iteration to study sequences and series, how to solve algebraic and differential equations numerically and how to study statistical properties of sets of numbers.

Books:

DJ & NJ Higham, *MATLAB guide*, SIAM Publications, Philadelphia, September 2000.

Additional Resources

Archived Pages: 2015 2016 2017 Marks 2018

MA125 Introduction to Geometry

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma125)
Lecturer: Andrea Mondino

Term(s): Term 1 (weeks 1-5)

Status for Mathematics students: List A for Maths

Commitment: Fifteen one-hour lectures

Assessment: One-hour exam taken in the summer term

Prerequisites:

Leads To: MA243 Geometry

Content: This module begins with a quick tour through elementary plane Euclidean geometry. We emphasise proof, and the careful use of diagrams as an aid to understanding problems and finding proofs. Plane geometry then provides the setting for an introduction to the geometry of the sphere and of polyhedra.

Aims:

- To learn and enjoy Euclidean geometry of the plane, the sphere and of three-dimensional space.
- To learn to visualise geometrical problems, and to draw diagrams which represent them accurately.
- To learn to reason from diagrams, and use them as an aid to writing rigorous proofs.
- To learn to construct proofs, and to set them out clearly and convincingly.

Objectives: You will gain familiarity with

- Plane Euclidean geometry: isometries, congruence and similarity; theorems on triangles, circles, tangents and angles; ruler and compass constructions.
- Polyhedra: the Euler characteristic; classification and construction of regular polyhedra.

- Spherical geometry: the angle-sum formula for spherical triangles; stereographic projection and its relation with inversion; conformal (angle-preserving) maps.

Books:

Notes for the module will be available at cost price from the departmental office.

Also relevant: G.A. Jennings, *Modern geometry with applications*, Springer-Verlag (a fine book with many challenging exercises, but useful only as a complement to the course).

Additional Resources

Archived Pages Pre-2011 2012 2016 2017

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

MA131 Analysis 1 and 2

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma131)
Lecturer:
Term 1: Florian Theil

Term 2: Richard Lissaman

Term(s): Terms 1-2

Status for Mathematics students:

Core for Maths.

CAUTION: This entry refers to arrangements for students based in the Mathematics Department (those who entered through the Mathematics Department and have a Personal Tutor there). There are different arrangements for students based elsewhere

Commitment: One lecture per week, two 2-hour classes per week
Please sign up for the classes here.

Assessment: First term: weekly assignments (7.5%); one-and-a-half-hour hour examination on the first term's work (25%) (held in the first week of the second term);
Second term:weekly assignments (7.5%); three-hour end-of-year examination (60%).

Content: At the beginning of the nineteenth century the familiar tools of calculus, differentiation and integration, began to run into problems. Mathematicians were unsure of how to apply these tools to sums of infinitely many functions. The origins of Analysis lie in their attempt to formalize the ideas of calculus purely in the the language of arithmetic and to resolve these problems.

You will study ideas of the mathematicians Cauchy, Dirichlet, Weierstrass, Bolzano, D'Alembert, Riemann and others, concerning sequences and series in term one, continuity and differentiability in term two and integration in term one of your second year.

By the end of the year you will be able to answer many interesting questions: What do we mean by `infinity'? How can you accurately compute the value of π or e or $\sqrt{2}$? How can you add up infinitely many numbers, or infinitely many functions? Can all functions be approximated by polynomials?

There will be considerable emphasis throughout the module on the need to argue with much greater precision and care than you had to at school. With the support of your fellow students, lecturers and other helpers, you will be encouraged to move on from the situation where the teacher shows you how to solve each kind of problem, to the point where you can develop your own methods for solving problems. You will also be expected to question the concepts underlying your solutions, and understand why a particular method is meaningful and another not so. In other words, your mathematical focus should shift from problem solving methods to concepts and clarity of thought.

Books:
M. Hart, *Guide to Analysis*, Macmillan. (A good traditional text with theory and many exercises.)
M. Spivak, *Calculus*, Benjamin.

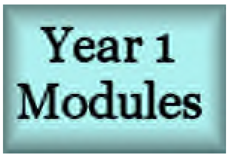
Recommended Syllabus

Additional Resources Analysis I (Term 1)

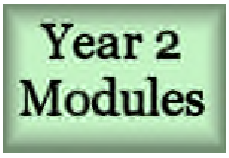
Archive: pre-2011

Additional Resources Analysis II (Term 2)

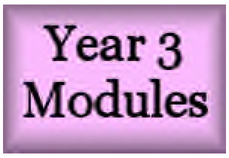
Archive: Pre-2011 2012 2013 2014 2015 2016 2017



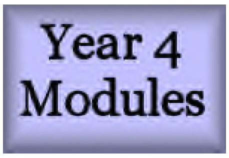
Year 1 regs and modules
G100 G103 GL11 G1NC



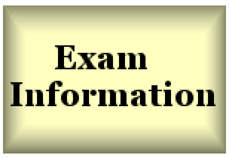
Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103



Year 4 regs and modules
G103



Past Exams
Core module averages

MA132 Foundations

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma132)
Lecturer: Oleg Kozlovski,

Term(s): Term 1

Status for Mathematics students: Core

Commitment: 30 lectures, 10 weekly assignments with 5 fortnightly tests based on them.

Assessment: 15% from fortnightly tests and 85% from a one-and-a-half hour written exam in the first week of Term 2.

Prerequisites: Grade A in A-level Maths or equivalent, plus an interest in how Mathematics is built up from logical foundations.

Leads To: Most later pure mathematics modules; specifically MA136 Introduction to Abstract Algebra, MA131 Analysis, MA106 Linear Algebra and MA251 Algebra I.

Aims: University mathematics introduces progressively more and more abstract ideas and structures, and demands more and more in the way of proof, until by the end of a mathematics degree most of the student's time is occupied with understanding proofs and creating his or her own. This is not because university mathematicians are more pedantic than schoolteachers, but because proof is how one knows things in mathematics, and it is in its proofs that the strength and richness of mathematics is to be found.

But learning to deal with abstraction and with proofs takes time. This module aims to bridge the gap between school and university mathematics, by beginning with some rather concrete techniques where the emphasis is on calculation, and gradually moving towards abstraction and proof.

Content:

1. **Number systems**
   Number systems: Natural numbers, integers. Rationals and real numbers. Existence of irrational numbers. Complex Numbers.
   Polar and exponential form of complex numbers. De Moivre's Theorem, n'th roots and roots of unity.
   Euclidean algorithm; greatest common divisor and least common multiple.
   Prime numbers, existence and uniqueness of prime factorisation. Infiniteness of the set of primes.
   Modular arithmetic. Congruence, addition and multiplication modulo n.

2. **Language and Proof**
   Proof by induction.
   Well-ordering Principle.
   Proof by contradiction.
   Basic set theory:$\cap$, $\cup$, Venn diagrams and de Morgan's Laws. Cartesian product of sets, power set.
   Logical connectives$\wedge$, $\vee$, $\Rightarrow$ and their relation with $\cap$, $\cup$ and $\subseteq$. Quantifiers $\forall$ and $\exists$.
3. **Sets, functions and relations**
   Injective, surjective and bijective functions.
   Inverse functions.
   Relations: equivalence relations, order relations.

4. **Polynomials**
   Multiplication and long division of polynomials.
   Euclidean algorithm for polynomials.
   Remainder theorem; a degree n polynomial has at most n roots.
   Algebraic and transcendental numbers. Fundamental theorem of
   Algebra (statement only).

5. **Counting**
   Cardinalities, including infinite cardinalities.
   Cardinality of the power set of X is greater than cardinality of X.
   Russell's paradox.
   Countability of the rational numbers, uncountability of the reals.
   Transcendental numbers exist!

Objectives:
Students will work with number systems and develop fluency with their properties; they will learn the language of sets and quantifiers, of functions and relations, and will become familiar with various methods and styles of proof.

Books:
None of these is the course text, but each would be useful, especially the first:
A.F.Beardon, *Algebra and Geometry*, CUP, 2005.
I.N. Stewart and D.O. Tall, *Foundations of Mathematics*, OUP, 1977.
J. A. Green, *Sets and Groups; First Course in Algebra*, Chapman and Hall, 1995.

Recommended Syllabus

MA133 Differential Equations

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma133)

Lecturer: Dave Wood

Term: Term 1

Status for Mathematics students: Core

Commitment: 30 lectures

Assessment: 15% from fortnightly assignments, 85% from a 2 hour examination

Prerequisites: None

Leads To: MA112 Experimental Mathematics, MA250 Partial Differential Equations, MA254 Theory of ODE, MA235 Introduction to Mathematical Biology, MA209 Variational Principles, MA371 Qualitative Theory of Differential Equations, MA394 Waves, MA3D1 Fluid Dynamics, MA235 Topics in Mathematical Physics, MA3G1 Theory of PDE, MA3J3 Bifurcations Catastrophes and Symmetry

There are also links with MA131 Analysis, MA106 Linear Algebra, MA124 Mathematics by Computer, MA222 Metric Spaces, MA228 Numerical Analysis.

Content: How do you reconstruct a curve given its slope at every point? Can you predict the trajectory of a tennis ball? The basic theory of ordinary differential equations (ODEs) as covered in this module is the cornerstone of all applied mathematics. Indeed, modern applied mathematics essentially began when Newton developed the calculus in order to solve (and to state precisely) the differential equations that followed from his laws of motion.

However, this theory is not only of interest to the applied mathematician: indeed, it is an integral part of any rigorous mathematical training, and is developed here in a systematic way. Just as a `pure' subject like group theory can be part of the daily armoury of the `applied' mathematician , so ideas from the theory of ODEs prove invaluable in various branches of pure mathematics, such as geometry and topology.

In this module we will cover relatively simple examples, first order equations

$$dy/dx = f(x, y),$$

linear second order equations

$$\ddot{x}(t) + p(t)\dot{x} + q(t)x = g(t)$$

and coupled first order linear systems with constant coefficients, for most of which we can find an explicit solution. However, even when we can write the solution down it is important to understand what the solution means, i.e. its `qualitative' properties. This approach is invaluable for equations for which we cannot find an explicit solution.

We also show how the techniques we learned for second order differential equations have natural analogues that can be used to solve difference equations.

The course looks at solutions to differential equations in the cases where we are concerned with one- and two-dimensional systems, where the increase in complexity will be followed during the lectures. At the end of the module, in preparation for more advanced modules in this subject, we will discuss why in three-dimensions we see new phenomena, and have a first glimpse of chaotic solutions.

Aims: To introduce simple differential and difference equations and methods for their solution, to illustrate the importance of a qualitative understanding of these solutions and to understand the techniques of phase-plane analysis.

Objectives: You should be able to solve various simple differential equations (first order, linear second order and coupled systems of first order equations) and to interpret their qualitative behaviour; and to do the same for simple difference equations.

Books:

The primary text will be:
J. C. Robinson *An Introduction to Ordinary Differential Equations*, Cambridge University Press 2003.

Additional references are:
W. Boyce and R. Di Prima, *Elementary Differential Equations and Boundary Value Problems*, Wiley 1997.
C. H. Edwards and D. E. Penney, *Differential Equations and Boundary Value Problems*, Prentice Hall 2000.
K. R. Nagle, E. Saff, and D. A. Snider, *Fundamentals of Differential Equations and Boundary Value Problems*, Addison Wesley 1999.

Recommended Syllabus

Additional Resources

Archived resources: 2011 2012

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams

Core module averages

MA134 Geometry and Motion

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma134)
Lecturer: Oleg Zaboronski

Term(s): Term 2

Status for Mathematics students:

Commitment: 30 lectures.

Assessment: 15% by marked homework, 85% by a 2 hour exam.

Prerequisites:

Leads To: This module leads on directly to MA259 Multivariable Calculus and, together with MA133 Differential Equations, thereby provides the foundations for most future applied mathematics modules, including MA112 Experimental Mathematics, MA250 Partial Differential Equations, MA209 Variational Principles. The geometric aspects of the module also lead on to MA3D9 Geometry of Curves and Surfaces. The proper theory of integration of functions of several variables is done in MA359 Measure Theory.

Content: When a particle moves in space, it traces out a curve. This is one of the simplest connections between geometry and motion. The motion contains more information than the curve traced out by the particle because the same curve can be traversed at different, possibly non-uniform, speeds (different motion). The length of the curve (a geometric property) is given by the integral (with respect to time) of the speed at which the curve is traversed. However, the length is evidently independent of the actual motion of the particle along the curve. This independence is established by means of the change of variables formula for integrals. Another connection between geometry and motion is provided by the relation between curvature and acceleration.

In high school, one learns how to integrate a function of one real variable. This course describes how to integrate vector-valued functions and functions of two and three real variables. In particular, the area of a surface and volume of a region (geometry) will be defined, as well as the circulation of a fluid around a closed curve (motion). The change of variables formula for two and three dimensional integrals will be (heuristically) derived; it involves a determinant and is somewhat more complicated than the one dimensional formula.

A section on particle mechanics will derive Kepler's Laws of planetary motion from Newton's second law of motion and the law of gravitation. The motion of the simple pendulum will also be discussed. This section reinforces the discussion of gradient flows in MA133 Differential Equations and introduces the notion of conserved quantities.

Aims: This module aims to indicate to students how intuitive geometric and physical concepts such as length, area, volume, curvature, mass, circulation and flux can be translated into mathematical formulas. It also aims to teach the practical calculation of these formulas and their application to elementary problems in particle and fluid dynamics. The importance of conserved quantities in mechanics is also highlighted.

Objectives: On successful completion of this module students should be able to:

- parametrise simple curves and surfaces, such as conic sections, helix, surface of revolution (including sphere, cylinder, paraboloid and torus), in cartesian and other coordinates, including polar, spherical polar and cylindrical coordinates.
- calculate lengths and curvatures of curves in 3-space and demonstrate that length is independent of parametrisation.
- understand and be able to calculate line, surface and volume integrals with respect to various coordinate systems. This includes change of variables and change of order of integration in repeated integrals. Please note that in the examination, *no formula sheets* will be provided. :-(
- to be able to determine whether a vector field is conservative and to calculate its potential when it is.
- apply all these techniques to elementary problems from fluid dynamics (mass, work, circulation and flux) and geometry (area and volume).
- understand basic notions from particle mechanics including momentum (linear and angular), force, work, energy (potential and kinetic), Newton's laws of motion, Newton's law of gravity, conservation laws. Students should also be able to apply all these principles to elementary problems from mechanics, including central force theory (including, but not restricted to, planetary motion) and the simple pendulum.

Books:

G.B. Thomas et al., *Calculus and Analytic Geometry*, Addison-Wesley. The course is concerned with only the later chapters of this massive book. However, the earlier chapters are relevant to other first year courses and even contain A-Level material from a different perspective. Any edition of this book is appropriate. You may be able to buy a cheap copy through Amazon.

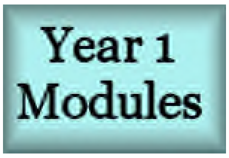
F.J. Flannigan and J.L. Kazdan, *Calculus Two*, Springer-Verlag. Again, the earlier chapters of this book are relevant to other first year courses.

J.E. Marsden and A.J. Tromba, *Vector Calculus*, Freeman. This book is more advanced than *Calculus Two* and is useful for the second year courses on Vector Analysis and Differentiation.

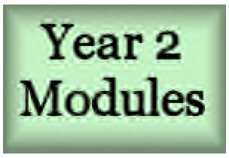
Recommended Syllabus

Additional Resources

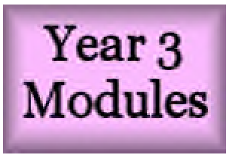
Archived Pages: 2011 2012 2013 2017



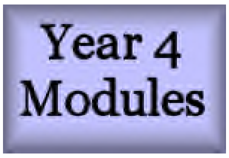
Year 1 regs and modules
G100 G103 GL11 G1NC



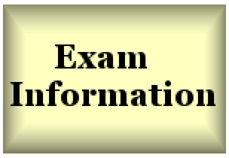
Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103



Year 4 regs and modules
G103



Past Exams
Core module averages

MA136 Introduction to Abstract Algebra

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ma136)
Lecturer: Hong Liu

Term(s): Term 1 (6-10)

Status for Mathematics students: Core for Maths

Commitment: 15 One hour lectures

Assessment: Weekly assignments (15%), 1 hour written exam (85%)

Corequisites: MA132 Foundations

Leads To:

Content:

Section 1 Group Theory:

- Motivating examples: numbers, symmetry groups
- Definitions, elementary properties
- Subgroups, including subgroups of Z
- Arithmetic modulo n and the group Z_n
- Lagrange's Theorem
- Permutation groups, odd and even permutations (proof optional)

- Normal subgroups and quotient groups

Section 2 Ring Theory:

- Definitions: Commutative and non-commutative rings, integral domains, fields
- Examples: Z, Q, R, C, Z_n, matrices, polynomials, Gaussian integers

Aims:

To introduce First Year Mathematics students to abstract Algebra, covering Group Theory and Ring Theory.

Objectives:

By the end of the module students should be able to understand:

- the abstract definition of a group, and be familiar with the basic types of examples, including numbers, symmetry groups and groups of permutations and matrices.
- what subgroups are, and be familiar with the proof of Lagrange's Theorem.
- the definition of various types of ring, and be familiar with a number of examples, including numbers, polynomials, and matrices.
- unit groups of rings, and be able to calculate the unit groups of the integers modulo n.

Books:

Any library book with Abstract Algebra in the title would be useful.

Additional Resources

Archived Pages 2013 2014 2015 2016 2017

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

ST104 Statistical Laboratory 1

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/st104)
Lecturer(s): Dr Panayiota Constantinou

Prerequisite(s): Either ST115 Introduction to Probability or ST111/2 Probability (taken concurrently).

Leads to: ST221 Linear Statistical Modelling

Commitment: This module runs in Term 2 and 3 and is weighted at 12 CATS.
Term 2: 3 lectures each in weeks 6-10 and 1 lab each in weeks 7-10,
Term 3: 3 lectures each in weeks 1-2, 4 lectures each in weeks 3-4 and 1 lab each in weeks 1-4.

Content:

1. Introduction to R
2. Exploratory data analysis: methods of visualisation and summary statistics
3. Sampling from standard discrete and continuous distributions (Bernoulli, Geometric, Poisson, Gaussian, Gamma)
4. Generic methods for sampling from univariate distributions
5. The use of R to illustrate probabilistic notions such as conditioning, convolutions and the law of large numbers
6. Examples of modelling real data (but without formal statistical inference) and the use of visualisations to assess fit

Aims: To introduce students to the R software package, making use of it for exploratory data analysis and simple simulations. This should deepen and reinforce the understanding of probabilistic notions being learnt in ST115 and ST111/2.

Objectives:

- A familiarity with the R software package, making use of it for exploratory data analysis.
- An understanding of elementary simulation techniques applied to probability.
- The ability to propose appropriate probabilistic models for simple data sets.

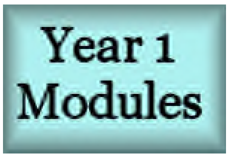
Assessment: 30% assessed work and 70% open-book examination.

Deadlines:

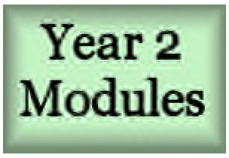
Term 2: Thursday of Week 10: Lab report 1 **(15%)**

Term 3: Thursday of Week 3: Lab report 2 **(15%)**

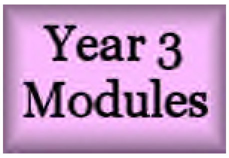
Feedback: Feedback to students will be given within 20 working days after the submission deadline.



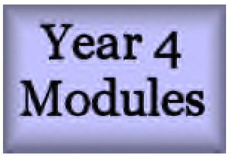
Year 1 regs and modules
G100 G103 GL11 G1NC



Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103



Year 4 regs and modules
G103

Exam Information

Past Exams

Core module averages

ST111 Probability A

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/st111)

Resources

Lecturer(s): Dr Jon Warren

Prerequisites: MA131 Analysis I, MA132 Foundations.

Leads to: ST104 Statistical laboratory, ST220 Introduction to Mathematical Statistics, ST202 Stochastic Processes, MA3H2 Markov processes and percolation theory, and to numerous statistical, probabilistic, operational research and econometric courses.

Commitment: This module runs in Term 2.

- ST111 - 15 hours of lectures, 2 tutorial hours (week 3 and week 5)
- ST112 - 15 hours of lectures, 2 tutorial hours (week 7 and week 9).

Aims: To lay the foundation for all subsequent modules in probability and statistics, by introducing the key notions of mathematical probability and developing the techniques for calculating with probabilities and expectations.

Content (part A):

1. Experiments with random outcomes: the notions of events and their probability. Operations with sets and their interpretation. The addition law and axiomatic definition of a probability space.
2. Simple examples of discrete probability spaces. Methods of counting: inclusion-exclusion formula and multinomial co-efficients. Examples including the birthday problem and coupon collecting.
3. Simple examples of continuous probability spaces. Points chosen uniformly at random in space.
4. Independence of events. Conditional probabilities. Simpson's paradox. Bayes theorem.
5. Binomial probabilities. The law of large numbers, Poisson and Gaussian approximations and their applications.

Content (part B):

1. The notion of a random variable and its distribution. Examples in both discrete and continuous settings. Probability mass functions and density functions. Cumulative distribution functions.
2. Joint distributions. Independence of random variables.
3. Expectation of random variables. Properties of expectation.
4. Variance and Chebyshev's inequality. Covariance and the Cauchy-Schwartz inequality.
5. Addition of independent random variables: convolutions. Generating functions, Moment generating functions and their use to compute convolutions.
6. Important families of distributions: Binomial, Poisson, negative Binomial, exponential, Gamma and Gaussian. Their properties, genesis and inter-relationships.
7. The law of large numbers and the Central limit theorem.

Books:

- Durrett, Elementary Probability for Applications.
- Grimmett and Walsh, Probability- An Introduction.
- Grimmett and Stirzaker, One Thousand Exercises in Probability
- Sheldon Ross, A first course in Probability.

Assessment: 10% assessed work (during term 2) and 90% written examination (in term 3).

Deadlines:

- ST111 assignments are due on Tuesdays of weeks 4 and 6
- ST112 assignments are due on Tuesdays of weeks 8 and 10

Feedback: Feedback on your assignments will be given within 2 weeks of submission

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ST112 Probability B

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/st112)

Resources

Lecturer(s): Dr Jon Warren

Prerequisites: MA131 Analysis I, MA132 Foundations.

Leads to: ST104 Statistical laboratory, ST220 Introduction to Mathematical Statistics, ST202 Stochastic Processes, MA3H2 Markov processes and percolation theory, and to numerous statistical, probabilistic, operational research and econometric courses.

Commitment: This module runs in Term 2.

- ST111 - 15 hours of lectures, 2 tutorial hours (week 3 and week 5)
- ST112 - 15 hours of lectures, 2 tutorial hours (week 7 and week 9).

Aims: To lay the foundation for all subsequent modules in probability and statistics, by introducing the key notions of mathematical probability and developing the techniques for calculating with probabilities and expectations.

Content (part A):

1. Experiments with random outcomes: the notions of events and their probability. Operations with sets and their interpretation. The addition law and axiomatic definition of a probability space.
2. Simple examples of discrete probability spaces. Methods of counting: inclusion-exclusion formula and multinomial co-efficients. Examples including the birthday problem and coupon collecting.
3. Simple examples of continuous probability spaces. Points chosen uniformly at random in space.
4. Independence of events. Conditional probabilities. Simpson’s paradox. Bayes theorem.
5. Binomial probabilities. The law of large numbers, Poisson and Gaussian approximations and their applications.

Content (part B):

1. The notion of a random variable and its distribution. Examples in both discrete and continuous settings. Probability mass functions and density functions. Cumulative distribution functions.
2. Joint distributions. Independence of random variables.
3. Expectation of random variables. Properties of expectation.
4. Variance and Chebyshev's inequality. Covariance and the Cauchy-Schwartz inequality.
5. Addition of independent random variables: convolutions. Generating functions, Moment generating functions and their use to compute convolutions.
6. Important families of distributions: Binomial, Poisson, negative Binomial, exponential, Gamma and Gaussian. Their properties, genesis and inter-relationships.
7. The law of large numbers and the Central limit theorem.

Books:

- Durrett, Elementary Probability for Applications.
- Grimmett and Walsh, Probability- An Introduction.
- Grimmett and Stirzaker, One Thousand Exercises in Probability
- Sheldon Ross, A first course in Probability.

Assessment: 10% assessed work (during term 2) and 90% written examination (in term 3).

Deadlines:

- ST111 assignments are due on Tuesdays of weeks 4 and 6
- ST112 assignments are due on Tuesdays of weeks 8 and 10

Feedback: Feedback on your assignments will be given within 2 weeks of submission

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

ST114 Games and Decisions

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/st114)
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Year 1 Modules

Year 1 regs and modules

G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules

G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules

G100 G103

Year 4 Modules

Year 4 regs and modules

G103

Exam Information

Past Exams

Core module averages

EC106 Introduction to Quantitative Economics

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ec106)

242 total students

40 total lecture hours

10 total seminars

50 total contact hours

24 CATS - Department of Economics

Principal Aims

To introduce quantitative economics to students with a relatively strong mathematical background and to extend this analysis through the use of mathematics.

Principal Learning Outcomes

At the end of the year students should have a good grasp of the main theories and be ready if they wish to embark upon more advanced economics options taught in the second year, in particular, EC220/221 Mathematical Economics 1, and EC204 Economics 2.

Syllabus

The focus is mainly on economic theory but "real world" applications of relevant theories will also be examined, subject to time limitations. The module will typically cover the following topics:

Term 1: microeconomics, which is concerned with the economic behaviour of individual consumers and producing firms, and their interaction in markets for goods, services and factors of production, strategic interaction and the analysis of externalities and public goods.

Term 2: macroeconomics, which is concerned with aggregate economic variables or the workings of the national economy as a whole: aggregate output (Gross Domestic Product or GDP), employment and unemployment, inflation, interest rates, the balance of payments, exchange rates, etc., and with government economic policies to influence these variables.

Context

Core Module	G300 - Year 1, Y602 - Year 1
Optional Module	G100 - Year 1, G103 - Year 1
Pre or Co-requisites	A-level Mathematics or the equivalent
Pre-requisite for	EC220, EC221
Restrictions	May not be taken by GL11 students or students on Economics-based degree programmes
Part-year Availability for Visiting Students	Available in the Spring term only (1 x test - 9.6 CATS) and in the Autumn and Spring terms together (2 x tests - 19.2 CATS)

Assessment

Assessment Method	Coursework (20%) + 2 hour exam (80%)
Coursework Details	Two 50 minute tests (worth 10% each)
Exam Timing	May/June

Exam Rubric

Time Allowed: 2 Hours.

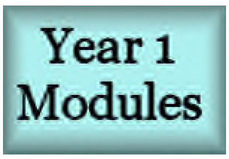
Answer ALL THREE questions from Section A (50 marks) and ALL THREE questions from Section B (50 marks). Answer Section A questions in one booklet and Section B questions in a separate booklet.

Approved pocket calculators are allowed.

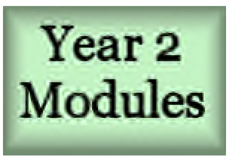
Read carefully the instructions on the answer book provided and make sure that the particulars required are entered on each answer book.

Previous exam papers can be found in the University's past papers archive. Please note that previous exam papers may not have operated under the same exam rubric or assessment weightings as those for the current academic year. The content of past papers may also be different.

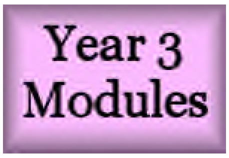
Reading Lists



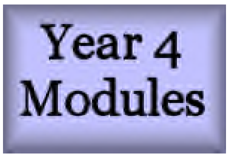
Year 1 regs and modules
G100 G103 GL11 G1NC



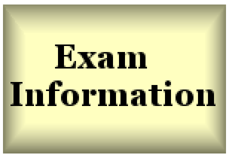
Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103



Year 4 regs and modules
G103



Past Exams
Core module averages

EC107 Economics 1

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ec107)

291 total students

40 total lecture hours

16 total seminars

56 total contact hours

30 CATS - Department of Economics

Principal Aims

To develop in students an understanding of fundamental and intermediate concepts in micro and macroeconomic analysis; to equip students with a range of appropriate analytical skills, including descriptive, graphical and mathematical methods; to develop the capacity to apply analytical techniques to real world problems.

Principal Learning Outcomes

To understand key concepts and principles in Economics

To demonstrate knowledge of economics trends, institutions and policies

To abstract and simplify economic problems through the application of theoretical models.

Syllabus

The module will typically cover the following topics:

Micro (term 1) - Market equilibrium, supply and demand; Household behaviour, choice and demand; Costs and Revenues; Market Structure and Firm Behaviour; The Firm's Factor Markets; Welfare Economics; International Trade. Macro (term 2) - Consumption, saving and investment; Aggregate demand, fiscal policy and foreign trade; IS and LM curve analysis; Fiscal and monetary policy; Aggregate supply; Open economy macroeconomics: the World economy; Economic growth and economic cycles.

Context

Core Module	LM1D (LLD2) - Year 1, V7ML - Year 1, GL11 - Year 1, GL12 - Year 1, L1L8 - Year 1, R9L1 - Year 1, R3L4 - Year 1, R4L1 - Year 1, R2L4 - Year 1, R1L4 - Year 1, V7MP - Year 1, V7MR - Year 1, V7MS - Year 1, V7MQ - Year 1, V7MM - Year 1
Optional Module	LA99 - Year 1
Pre or Co-requisites	For students outside of Economics, Grade B or better in Mathematics at A-level, or the equivalent. For Joint Degree Modern Language Students Grade A/Grade 7 in Mathematics at GCSE, or the equivalent.
Pre-requisite for	EC204, EC237
Restrictions	Not available to WBS students or students taking L100 or L116
Part-year Availability for Visiting Students	Not available on a part-year basis

Assessment

Assessment Method	Coursework (20%) + 3 hour exam (80%)
Coursework Details	Two assignments: Assignment 1 (10%), Assignment 2 (10%)
Exam Timing	May/June

Exam Rubric

Time Allowed: 3 Hours

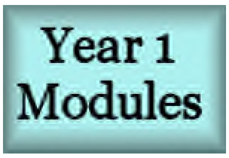
Answer ALL FOUR questions in Section A (40 marks). Answer ONE question from Section B, ONE question from Section C, and ONE OTHER question, which may be from EITHER Section B or Section C (20 marks each). Answer Section A questions in one booklet, Section B questions in a separate booklet; and Section C questions in a separate booklet

Approved pocket calculators are allowed.

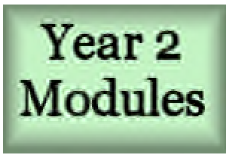
Read carefully the instructions on the answer book provided and make sure that the particulars required are entered on each answer book. If you answer more questions than are required and do not indicate which answers should be ignored, we will mark the requisite number of answers in the order in which they appear in the answer book(s): answers beyond that number will not be considered.

Previous exam papers can be found in the University’s past papers archive. Please note that previous exam papers may not have operated under the same exam rubric or assessment weightings as those for the current academic year. The content of past papers may also be different.

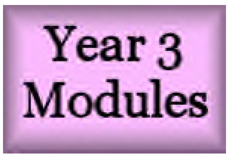
Reading Lists



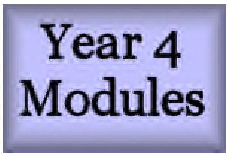
Year 1 regs and modules
G100 G103 GL11 G1NC



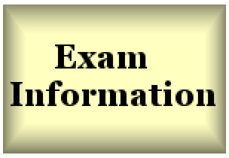
Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103



Year 4 regs and modules
G103



Past Exams
Core module averages

CS126 Design of Information Structures

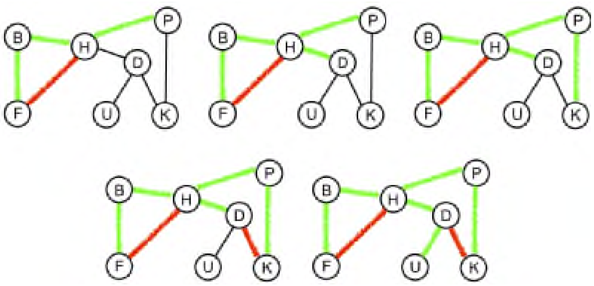
(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/cs126)
CS126 is all about data structures and how to program them.

We are interested in:

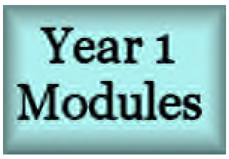
- what common data structures exist;
- how we can *program* those data structures;
- how we can represent them *efficiently*;
- how we can *reason* about them (in a formal manner).

We are also interested in common *algorithms* that use data structures, including:

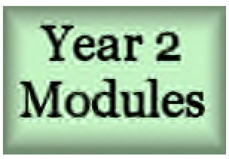
- *searching* for data;
- *sorting* data.



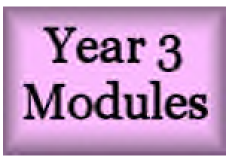
After you have completed the introductory programming module (CS118), you will understand the basic structures and concepts underpinning object-oriented programming. This module builds upon these foundations, and allows you to write large programs which use large data sets.



Year 1 regs and modules
G100 G103 GL11 G1NC



Year 2 regs and modules
G100 G103 GL11 G1NC



Year 3 regs and modules
G100 G103

CS137 Discrete Mathematics and its Applications 2

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/cs137)

Academic Aims

To introduce students to language and methods of the area of Discrete Mathematics. The focus of the module is on basic mathematical concepts in discrete mathematics and on applications of discrete mathematics in algortihms and data structures. To show students how discrete mathematics can be used in modern computer science (with the focus on algorithmic applications).

Learning Outcomes

On completion of the module the student should:

- Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
- Understand the basics of discrete probability and number theory, and be able to apply the methods from these subjects in problem solving.
- Be able to use effectively algebraic techniques to analyse basic discrete structures and algorithms.
- Understand asymptotic notation, its significance, and be able to use it to analyse asymptotic performance for some basic algorithmic examples.
- Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

Content

- Introduction to combinatorics: counting techniques, pigeonhole principle, inclusion-exclusion.
- Recurrence relations, solving recurrences using generating functions.
- Master Theorem for solving recurrences.
- Graphs. Basic graph algorithms. Trees. Applications of graphs.
- Applications of linear algebra and matrix algebra in algorithms (e.g., in web searching).
- Algorithmic applications of random processes and Markov chains, for example, cover time in graphs and card shuffling.
- Partitions, enumerations with symmetries.

PX101 Quantum Phenomena

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/px101)

Lecturer: Oleg Petrenko

Weighting: 6 CATS

This module begins by showing how classical physics is unable to explain some of the properties of light, electrons and atoms. (Theories in physics, which make no reference to quantum theory, are usually called classical theories.) It then deals with some of the key contributions to the development of quantum physics including those of: Planck, who first suggested that the energy in a light wave comes in discrete units or 'quanta'; Einstein, whose theory of the photoelectric effect implied a 'duality' between particles and waves; Bohr, who suggested a theory of the atom that assumed that not only energy but also angular momentum was quantised; and Schrödinger who wrote down the first wave-equations to describe matter.

Aims:
To describe how the discovery of effects which could not be explained using classical physics led to the development of quantum theory. The module should develop the ideas of wave-particle duality and introduce the wave theory of matter based on Schrödinger's equation.

Objectives:
At the end of the module you should be able to:

1. Discuss how key pieces of experimental evidence implied a wave-particle duality for both light and matter
2. Discuss the background to and issues surrounding Schrödinger's equation. This includes the interpretation of the wavefunction and the role of wavepackets and stationary states
3. Manipulate the time-independent Schrödinger equation for simple 1-dimensional potentials

Syllabus:

Waves, particles and thermodynamics before quantum theory

Light
Thermal radiation and the origin of Quantum Theory: Blackbody Radiation, derivation for the case of a `1D black-body', the idea of modes, Wien's law, Rayleigh-Jeans formula, Planck's hypothesis and $E=hf$. The photoelectric effect - Einstein's interpretation.

Waves or Particles? Interference a problem for the particle picture; the Compton effect - direct evidence for the particle nature of radiation.

Matter
Atoms and atomic spectra a problem for classical mechanics. Bohr's Model of the Atom: quantization of angular momentum, atomic levels in hydrogen. De Broglie's hypothesis. Experimental verification of wave-like nature of electrons - electron diffraction

Quantum Mechanics
Correspondence Principle. The Schrödinger wave equation. Relation of the wavefunction to probability density. Probability distribution, need for normalization. Superpositions of waves to give standing waves, beats and wavepackets. Gaussian wavepacket. Use of wavepackets to represent localized particles. Group velocity and correspondence principle again. Wave-particle duality, Heisenberg's uncertainty principle and its use to make order of magnitude estimates.

Using Schrödinger's equation
Including the effect of a potential. Importance of stationary states and time-independent Schrödinger equation. Infinite potential well and energy quantization. The potential step - notion of tunnelling. Alpha decay of nuclei. Status of wave mechanics.

Commitment: 15 Lectures + 5 problems classes

Assessment: 1 hour examination

Recommended Texts: H D Young and R A Freedman, University Physics, Pearson.

This module has a home page with links to various documents and biographies.

Leads from: A-level Physics and Mathematics

Leads to: PX262 Quantum Mechanics and its Applications

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

PX120 Electricity & Magnetism

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/px120)

Lecturer: Erwin Verwichte

Weighting: 12 CATS

This module is largely concerned with the great developments in electricity and magnetism, which took place during the nineteenth century. The origins and properties of electric and magnetic fields in free space and in materials are tested in some detail and all the basic levels up to, but not including, Maxwell's equations are considered. In addition the module deals with both dc and ac circuit theory including the use of complex impedance.

Aims:
To introduce the properties of electrostatic and magnetic fields, and their interaction with dielectrics, conductors and magnetic materials. To introduce some of their practical effects and the behaviour of simple passive circuits and networks.

Objectives:
At the end of this module you should:

- Understand the concepts of charge, field and flux.
- Be able to compute the electrostatic and magnetic fields for simple distributions of monopoles or dipoles.
- Understand in outline the interaction between electrostatic or magnetic fields and different classes of material (dielectric materials, dia-, para-, and ferro- magnetic materials).
- Understand the phenomena of capacitance and inductance.
- Know the laws of electromagnetic induction and be able to apply them to calculate self- and mutual inductance. You should understand the behaviour of electricity generators and electric motors, and be able to find the energy in simple magnetic fields.
- Understand the phenomenon of resistance and be able to calculate the current and potential distributions in simple DC networks

- Know how the various passive circuit elements (resistors, capacitors and inductors) behave when subject to alternating emf's and be able to use complex impedances to simplify such problems.
- Be able to explain the properties of simple LCR circuits.

Syllabus:
Introduction: Field forces, history, the concepts of charge and flux, stationary and moving charges.

Essential Mathematics I: Solid angle, integration and vectors, area as a vector, coordinate systems.

Elements: Gauss' Theorem, monopole and dipole sources.

Electrostatics:, electric field of a point charge, principle of superposition, application of Gauss' Theorem to **E**, Coulomb's law, work and electrical potential, exchange of electrostatic and kinetic energy.

The electric dipole: field and moment, addition of dipole moments, forces on dipoles in electric fields, dielectric materials and polarization.

Capacitance: capacitors, stored energy, capacitors in series, capacitors in parallel.

Magnetostatics: Magnetic field of a current, magnetic dipole and Gauss' Theorem, the Biot-Savart Law, Ampere's circuital law, forces on and between conductors, forces on individual moving charges, torque on a current loop/magnetic dipole, the dipole moment.

Electromagnetic Induction: Faraday's law, Lenz's principle, motional e.m.f., flux - cutting law, electric generators, electric motors, self-inductance, mutual inductance, magnetic energy, inductors in series and in parallel.

Magnetic dipoles in materials, magnetization, paramagnetics, diamagnets and ferromagnets, magnetization surface current.

D.C. Circuits: The electric circuit, energy relationships, Kirchoff's laws, Maxwell loop currents, use of symmetry, superposition principle, Thevenin's theorem, Norton's theorem.

Essential Mathematics II: Complex numbers, Euler's representation.

Transient Response: Capacitors, inductors, LCR circuits.

Sinusoidal Currents and EMF's: Capacitors, Inductors, Resistors, the concept of phasors, complex impedance, a.c. power and the power factor, series resonant LCR circuits, quality factor, voltage magnification, parallel resonant LCR circuit, filters, a.c. bridges.

Commitment: 30 Lectures + 10 problems classes

Assessment: 2 hour examination

This module has a home page.

Recommended Text: H D Young and R A Freedman, University Physics , Pearson. also W.J.Duffin, *Electricity and Magnetism*, McGraw-Hill; R Feynman, *Feynman Lectures on Physics vol. II*, Addison-Wesley.

Leads from: A level Physics

Leads to: PX 263 Electromagnetic Theory and Optics

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

PX121 Thermal Physics I

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/px121)

Lecturer: Neil Wilson

Weighting: 6 CATS

Aims:

The module introduces kinetic theory and the methods of classical thermodynamics. These can be used to determine the behaviour of certain physical parameters in a model-independent fashion, using only the results of experimental measurements of other physical quantities. The results of thermodynamics are fundamental to physics and will be used in later years in the description of all forms of matter and energy.

Objectives:

At the end of the module you should

- Be familiar with solid, liquid and gas phases of matter and how their properties depend on thermal motion and the forces between atoms and molecules.
- Have a working knowledge of the kinetic theory of gases and how this relates to what is actually observed in real gases
- Be able to explain and use the first and second laws of thermodynamics to solve some simple problems concerned with heat and work changes in systems. You should know the fundamental limits for the efficiency of heat engines, and be able to derive the thermodynamic temperature scale from the operation of an ideal Carnot heat engine.

Syllabus:

Heat and Temperature
The zeroth law of thermodynamics: thermal equilibrium, thermometry and temperature scales.
Thermal expansion
Heat capacity and phase changes
Heat transport.

Modelling of ideal gases
Equations of state and isotherms
Kinetic model of gases
Equipartition of energy and heat capacities
Interactions and the condensed phases

First law of thermodynamics.
Thermodynamic systems and processes
Internal energy and heat capacity
Adiabatic processes

Second law of thermodynamics.
Reversible and irreversible processes
Heat engines: petrol engine (Otto cycle), refrigerators and heat pumps
Second Law: Clausius and Kelvin- Planck statements
Carnot cycles and Carnot heat engines
Entropy and entropy changes

Commitment: 15 Lectures + 3 problems classes

Assessment: 1 hour examination

Recommended Text: H D Young and R A Freedman, University Physics, Pearson.

Leads from: A level Physics and Mathematics

Leads to: PX265 Thermal Physics II

PX144 Introduction to Astronomy

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/px144)

Lecturer: Pier-Emmanuel Tremblay

Weighting 6 CATS

The Universe contains a bewildering variety of objects - black-holes, red giants, white dwarfs, brown dwarfs, gamma-ray bursts and globular clusters - to name a few. The module introduces these, and shows how, with the application of physics, we have come to know their distances, sizes, masses and natures. The module starts with the Sun and planets and moves on to the Universe as a whole.

Aims:
To introduce the constituent objects of the Universe and the physics which allows us to estimate their distances, sizes, masses and natures. The module will show how our knowledge of the Universe beyond Earth relies upon the application and extrapolation of physics developed in the laboratory.

Objectives:

At the end of the module you should be able to:

- List the main constituents of the Universe and give a basic description of them
- Describe methods for measuring the distances of stars and galaxies and work out example computations.
- Estimate the masses of stars and galaxies given information on size or angle & distance and speed.
- Explain how the surface temperature of stars can be measured and how one can deduce physical conditions of their interiors.

Syllabus:

Description of the main constituents of the Universe with typical sizes, masses and distances covering: the Solar System. Stars and star clusters Angles, distances & sizes: angular size and the small-angle approximation; trigonometric parallax; simple telescopes; distance methods based upon the inverse square law of brightness.

Masses: the Doppler effect and the measurement of speed from spectra; the use of speeds and sizes to derive masses in the Solar System, binary stars, star clusters and galaxies.

Physical properties of stars: stellar temperatures; spectra and elemental compositions. Physical conditions within stars

Galaxies: normal & active; the Milky Way; galaxy interactions; galaxy clusters.

The Universe: Hubble's discovery of the expansion of the Universe; implication of a finite age; the Cosmic Microwave Background; the composition of the Universe.

Commitment: 15 Lectures + 5 problems classes

Assessment: 1 hour examination

This module has a home page.

Recommended Texts: Marc Kutner, *Astronomy: a Physical perspective* , CUP

Leads from: A level Physics

Leads to: PX268 Stars

Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
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Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

PX147 Introduction to Particle Physics

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/px147)

Lecturer: Steve Boyd

Weighting: 6 CATS

The elementary constituents of matter are classified into three generations of quarks and leptons (electrons and neutrinos), which interact with each other through the electromagnetic, the weak and the strong forces. An account of how to classify the elementary particles and their interactions, and a description of some of the experimental tools used to probe their properties, is the subject of this introductory module. The module discusses the relationship between conservation laws and the symmetry of the families of elementary particles. Understanding this relationship is the key to understanding how elementary particles behave. We look at which quantities are conserved by which interactions and how this allows us to interpret simple reactions between particles. We also study how elementary particles interact with matter. One example is that of neutrinos in cosmic rays and their interaction with the earth's atmosphere.

Aims:
To provide an introduction to elementary particle physics including the naming and classification of particles, their detection and their interaction with matter.

Objectives:
At the end of the module you should be able to:

1. Define the main terms in use to classify and name the elementary particles. Make correct charge and flavour assignments to all the quark and lepton flavours.
2. Discuss qualitatively the relationship between symmetries and conservation laws. Know the conserved quantities of the four fundamental interactions and be able to make simple applications of conservation laws.
3. Be able to write-down the classical equation of motion for a charged particle in uniform magnetic and electric fields (non-radiative approximation), and solve for its motion in each case. Be able to discuss the main principles behind cathode ray tubes, mass spectrometers and particle accelerators.
4. Be able to discuss qualitatively, several natural sources of radiation. Eg. Natural radioactivity, cosmic rays, solar and atmospheric neutrinos. Be able to calculate decay length of relativistic muon. Be able to discuss qualitatively the solar and atmospheric neutrino anomalies.
5. Describe the main processes at work when particles of different types pass through matter. Be able to describe the principles behind the operation of common particle detectors.

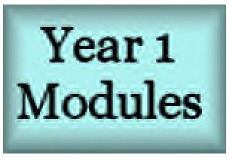
Syllabus:

1. Introduction: the Guiding Principles of Elementary Particle Physics: Simplicity, Composition, Symmetry, Unification
2. Quarks and Leptons as basic building blocks: Periodic Table of Quarks and Leptons Basic compostion rules for hadrons
3. The four forces and their roles: Electromagnetism, Gravity, Strong nuclear force, Weak nuclear force.
4. Symmetries and conservation laws Introduction through simple examples Qualitative treatment of relationship between symmetries and conservation Laws Conservations Laws of EPP.
5. Particle Physics in the natural world: Natural radioactivity, source of geothermal energy Cosmic rays Natural sources of neutrinos: radioactivity, solar, atmospheric.
6. Charged particles in electric and magnetic fields. e/m of the electron, Mass spectrometry, Cathode ray tube. Particle accelerators.
7. Interactions of particles with matter. Ionisation. Pair creation by photons and Bremsstrahlung. Hadronic interactions. Exponential probability of interaction: radiation and interaction lengths.
8. Particle Detectors.
9. The Big questions. Origin of Mass and the Higgs Grand Unification as a goal. Neutrino character and mass

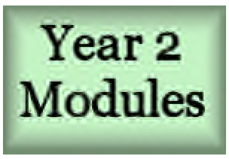
This module has a home page.

Recommended Text: H D Young and R A Freedman, University Physics, Pearson.

Leads from: A-level Physics and Mathematics



Year 1 regs and modules
G100 G103 GL11 G1NC



Year 2 regs and modules
G100 G103 GL11 G1NC

PX148 Classical Mechanics & Relativity

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/px148)

Lecturer: David Quigley

Weighting: 12 CATS

By 1905, there was a successful theory (Newton's laws) describing the motion of massive bodies and there was a successful theory of light waves (Maxwell's equations of electromagnetism). But the two theories are inconsistent: in mechanics objects only move relative to each other, whereas light appears to move relative to nothing at all (the vacuum). Physicists (including Maxwell himself) had therefore assumed that there had to be some background 'ether', through which light propagated. But all attempts to detect this ether had failed. Einstein realised that there was nothing wrong with Maxwell's equations and that there was no need for an ether. Newtonian mechanics itself was the problem. He proposed that the laws of classical mechanics had to be consistent with just two postulates, namely that the speed of light is a constant and that all frames of reference are equivalent. These postulates forced Einstein to reject previous ideas of space and time and led directly to the special theory of relativity.

This module studies Newtonian mechanics emphasizing the conservation laws inherent in the theory. These have a wider domain of applicability than classical mechanics (for example they also apply in quantum mechanics). It also looks at the classical mechanics of oscillations and of rotating bodies. It then explains why the failure to find the ether was such an important experimental result and how Einstein constructed his theory of special relativity. The module covers some of the consequences of the theory for classical mechanics and some of the predictions it makes, including: the relation between mass and energy, length-contraction, time-dilation and the twin paradox.

Aims:
To revise A-level classical mechanics and to develop the theory using vector notation and calculus. To introduce special relativity. To cover material required for future physics modules.

Objectives:
At the end of the module, you should be

- Able to solve **F** =d **p** /dt for a variety of simple cases;
- Familiar with the concepts of potential and kinetic energy;
- Able to recognise and solve the equations of forced and damped harmonic motion;
- Able to solve problems involving torque and angular momentum;
- Able to explain the transformation between inertial frames of reference (Lorentz transformation) and to work through illustrative problems.

Syllabus:
Forces, interactions and Newton's Laws of Motion

Applying Newton's Laws - equilibrium, dynamics of particles, friction and dynamics of circular motion Work and kinetic energy.

Potential energy and energy conservation.

Conservation of momentum, elastic collisions, centre of mass

Rotation of rigid bodies - angular velocity and acceleration, Dynamics of rotational motion, conservation of angular momentum

Hooke's law, equation of motion for a mass attached to a spring on a frictionless plane. Solutions for shm. Energy in shm. The pendulum, departures from shm for large amplitude. Complex notation. Damping: critical and under-/over-damping. Forced oscillations.

Motion as seen by different observers. Galilean Transformation of Velocities. Inertial frames of reference

The Michelson Morley experiment. The universality of the speed of light. The meaning of simultaneity.

Einstein's postulates: Lorentz transformation, Inverse Lorentz transformation and invariants. Length Contraction and Time Dilation, Doppler Effect.

Einstein's energy and mass relation, energy and momentum of elementary particles.

Minkowski diagrams - graphical representation of past/present/future.

Commitment: 30 Lectures + 10 problems classes

Assessment: 2 hour examination

This module has a home page.

Recommended Text: H D Young and R A Freedman, University Physics, Pearson.

Leads from: A level Physics and Mathematics

PH121 Issues in Philosophy

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph121)
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Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

PH123 Elements of Scientific Method

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph123)
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Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams

Core module averages

PH136 Logic I: Introduction to Symbolic Logic

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph136)
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Year 1 Modules

Year 1 regs and modules

G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules

G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules

G100 G103

Year 4 Modules

Year 4 regs and modules

G103

Exam Information

Past Exams

Core module averages

PH128 Descartes & Mill

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph128)
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Year 1 Modules

Year 1 regs and modules

G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules

G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules

G100 G103

Year 4 Modules

Year 4 regs and modules

G103

Exam Information

Past Exams

Core module averages

PH131 Doing Philosophy of Mathematics

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph131)
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Year 1 Modules

Year 1 regs and modules

G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules

G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules

G100 G103

Year 4 Modules

Year 4 regs and modules

G103

Exam Information

Past Exams

Core module averages

PH142 Central Themes in Philosophy

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph142)
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Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
G100 G103 GL11 G1NC

Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules
G103

Exam Information

Past Exams
Core module averages

PH144 Mind and Reallity

(https://warwick.ac.uk/fac/sci/maths/undergrad/ughandbook/year1/ph144)
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Year 1 Modules

Year 1 regs and modules
G100 G103 GL11 G1NC

Year 2 Modules

Year 2 regs and modules
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Year 3 Modules

Year 3 regs and modules
G100 G103

Year 4 Modules

Year 4 regs and modules

G103

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