Swansea University
Prifysgol Abertawe

FACULTY OF SCIENCE AND ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 0 (FHEQ LEVEL 3)

MATHEMATICS AND COMPUTER SCIENCE

DEGREE PROGRAMMES

SUBJECT SPECIFIC
PART TWO OF TWO
MODULE AND COURSE STRUCTURE
2022-23

DISCLAIMER

The Faculty of Science and Engineering has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The Faculty of Science and Engineering reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules. You are advised to contact the Faculty of Science and Engineering directly if you require further information.

The 22-23 academic year begins on 26 September 2022

Full term dates can be found here

DATES OF 22-23 TERMS

26 September 2022 – 16 December 2022

9 January 2023 – 31 March 2023

24 April 2023 – 09 June 2023

SEMESTER 1

26 September 2022 – 27 January 2023

SEMESTER 2

30 January 2023 – 09 June 2023

SUMMER

12 June 2023 – 22 September 2023

IMPORTANT

Swansea University and the Faculty of Science of Engineering takes any form of **academic misconduct** very seriously. In order to maintain academic integrity and ensure that the quality of an Award from Swansea University is not diminished, it is important to ensure that all students are judged on their ability. No student should have an unfair advantage over another as a result of academic misconduct - whether this is in the form of **Plagiarism**, **Collusion** or **Commissioning**.

It is important that you are aware of the **guidelines** governing Academic Misconduct within the University/Faculty of Science and Engineering and the possible implications. The Faculty of Science and Engineering will not take intent into consideration and in relation to an allegation of academic misconduct - there can be no defence that the offence was committed unintentionally or accidentally.

Please ensure that you read the University webpages covering the topic – procedural guidance here and further information here. You should also read the Faculty Part One handbook fully, in particular the pages that concern Academic Misconduct/Academic Integrity. You should also refer to the Faculty of Science and Engineering proof-reading policy and this can be found on the Community HUB on Canvas, under Course Documents.

Welcome to the Faculty of Science and Engineering!

Whether you are a new or a returning student, we could not be happier to be on this journey with you.

This has been a challenging period for everyone. The COVID-19 pandemic has prompted a huge change in society as well as how we deliver our programmes at Swansea University and the way in which you study, research, learn and collaborate. We have been working hard to make sure you will have or continue to having an excellent experience with us.

We have further developed some exciting new approaches that I know you will enjoy, both on campus and online, and we cannot wait to share these with you.

At Swansea University and in the Faculty of Science & Engineering, we believe in working in partnership with students. We work hard to break down barriers and value the contribution of everyone. Our goal is an inclusive community where everyone is respected, and everyone's contributions are valued. Always feel free to talk to academic staff, administrators, and your fellow students - I'm sure you will find many friendly helping hands ready to assist you.

We all know this period of change will continue and we will need to adapt and innovate to continue to be supportive and successful. At Swansea we are committed to making sure our students are fully involved in and informed about our response to challenges.

In the meantime, learn, create, collaborate, and most of all – enjoy yourself!

Professor Johann (Hans) Sienz
Interim Pro-Vice Chancellor/Interim Executive Dean
Faculty of Science and Engineering

Faculty of Science and Engineering	
Interim Pro-Vice Chancellor/Interim Executive Dean	Professor Johann Sienz
Head of Operations	Mrs Ruth Bunting
Associate Dean – Student Learning and Experience (SLE)	Professor Paul Holland
School of Mathematics and Computer Science **Head of School: Professor Elaine Crooks**	
School Education Lead	Dr Neal Harman
Head of Mathematics	Professor Vitaly Moroz
Mathematics Programme Director	Dr Kristian Evans
Year Coordinators	Year 0 – Dr Zeev Sobol Year 1 – Dr Noemi Picco Year 2 – Professor Jiang-Lun Wu Year 3 – Dr Grigory Garkusha Year 4/MSc – Professor Chenggui Yuan

STUDENT SUPPORT

The Faculty of Science and Engineering has two **Reception** areas - Engineering Central (Bay Campus) and Wallace 223c (Singleton Park Campus).

Standard Reception opening hours are Monday-Friday 9am-5pm.

The **Student Support Team** provides dedicated and professional support to all studentsin the Faculty of Science and Engineering. Should you require assistance, have any questions, be unsure what to do or are experiencing difficulties with your studies or in your personal life, our team can offer direct help and advice, plus signpost you to further sources of support within the University. There are lots of ways to get information and contact the team:

Email: studentsupport-scienceengineering@swansea.ac.uk (Monday–Friday, 9am–5pm)

Call: +44 (0) 1792 295514 and 01792 6062522 (Monday-Friday, 10am–12pm, 2–4pm).

Zoom: By appointment. Students can email, and if appropriate we will share a link to our Zoom calendar for students to select a date/time to meet.

The current student **webpages** also contain useful information and links to otherresources:

https://myuni.swansea.ac.uk/fse/coe-student-info/

READING LISTS

Reading lists for each module are available on the course Canvas page and are also accessible via http://ifindreading.swan.ac.uk/. We've removed reading lists from the 22-23 handbooks to ensure that you have access to the most up-to-date versions. Access to print material in the library may be limited due to CV-19; your reading lists will link to on-line material whenever possible. We do not expect you to purchase textbooks, unless it is a specified key text for the course.

THE DIFFERENCE BETWEEN COMPULSORY AND CORE MODULES

Compulsory modules must be **pursued** by a student.

Core modules must not only be **pursued**, but also **passed** before a student can proceed to the next level of study or qualify for an award. Failures in core modules must be redeemed.

Further information can be found under "Modular Terminology" on the following link - https://myuni.swansea.ac.uk/academic-life/academic-regulations/taught-guidance/essential-info-taught-students/your-programme-explained/

Year 0 (FHEQ Level 3) 2022/23
Mathematics and Computer Science
BSc Mathematics and Computer Science[GS08]

Coordinator: Dr Z Sobol

Semester 1 Modules	Semester 2 Modules
CSC061 **Introduction to Programming** **15 Credits** **Dr JS Pearson/Ms L Powell**	**CSC009** **Technologies for Information Presentation** **15 Credits** **Mrs S Safari**
CSC079 **Fundamentals of Robotics** **15 Credits** **Dr DR Sahoo**	**EG-066** **Basic Engineering Analysis 2** **20 Credits** **Dr AJ Williams/Dr M Khalifa** **CORE**
MA-006 **Fundamental Mathematics** **15 Credits** **Dr I Rodionova** **CORE**	**MA-004** **Fundamental Geometry** **15 Credits** **Dr Z Sobol** **CORE**
MA-009 **Computational Probability** **15 Credits** **Prof IM Davies** **CORE**	**MA-010** **Further Fundamental Mathematics** **10 Credits** **Prof J Wu** **CORE**
Total 120 Credits	

CSC009 Technologies for Information Presentation

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Mrs S Safari

Format: Lectures & lab classes

Delivery Method: On-campus/virtual lectures and lab sessions.

Module Aims: This module is about the technologies and markup languages that make various forms of data presentation possible. It will explore web-based presentation languages including HTML, XML and CSS, text presentation languages including LaTeX, and mathematical / graphical presentation through R.
After studying this module, students will be able to build web sites, produce professional-quality reports and typeset and visualize mathematical formulae and data, using the appropriate graphs for the data.
The students will also be able to produce a crawler / scraper that can pull data from websites automatically for analysis.

Module Content: Markdown vs. Markup
HTML
• Writing HTML
• Understanding structure of web-pages and sites
CSS
• CSS syntax
• Basic styling
• IDs and classes
XML
• Relationship to HTML and CSS
• XPath
LaTeX
• Document class
• Formatting
• Floats
• Typesetting mathematics
• BibTeX
R
• Concepts of ‘Tidy’ data
• The ‘TidyVerse’
• The graphical grammar (ggplot)
• R and HTML
• Shiny / RMarkdown / Shinydashboard
Graphical presentation concepts
• Which graph should you use for your data?

Intended Learning Outcomes: After completing this module students will be able to:
• Explain and apply HTML to the development of web content.
• Explain the separation of content and format, and apply CSS to format web pages.
• Explain the role of XML and be able to use XPath to find an element in an XML tree.
• Explain the syntax and function of LaTeX; develop documents using LaTeX
• Understanding of R and knowledge of the features it provides and how to apply them for graphical data presentation.
• Understand the fundamental concepts of graphical data presentation, including how to choose a graph type for a specific data set.

Assessment:	Coursework 1 (10%) Coursework 2 (10%) Laboratory 1 (10%) Examination (70%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Coursework 1 : practical web development exercise with CSS.
Coursework 2: practical development exercise with R , HTML and LaTeX.
Labs : Guided and supported laboratory sessions .
Exam: Standard Computer Science format unseen examination, duration 2hrs

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Outline solutions provided along with analytical individual feedback for coursework's. Examination feedback summarising strengths and weaknesses of the class. Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.

Failure Redemption: Resit examination and/or resubmit coursework(s) as appropriate.

Additional Notes:

Updated September 2017. Available to visiting and exchange students.

CSC061 Introduction to Programming

Credits: 15 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr JS Pearson, Ms L Powell

Format: 30 hours lectures and practicals

Delivery Method: On-campus/virtual lectures and lab sessions.

Module Aims: This module gives an overview of the main topics and questions in Computer Science and enables students who are not majoring in computer science to reach a level of skill in programming such that they will be able to apply their computing knowledge to their other studies. It can also provide (along with other Level 0 modules) a suitable preparation for Level 1 Computer Science.

Module Content: This module teaches students the fundamentals of programming in Python. Students will learn to develop and debug simple programs using basic programming concepts (assignments, if statements, loops, functions) and simple data types (integers, floating-point numbers and strings).

Intended Learning Outcomes: Students will have gained an insight into the main questions of Computer Science. Students will have the ability to analyse, write and appropriately structure programs in Python.
Along with other Level 3 modules they will have gained background knowledge to enable them to proceed to level 4 Computer Science.

Assessment: Examination 1 (70%)
Coursework 1 (10%)
Coursework 2 (10%)
Laboratory work (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination, duration 2hrs.
Coursework 1 and 2 - practical programming exercises.
Laboratory - supported sessions working through pre-defined exercises.

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks.
Examination feedback summarising strengths and weaknesses of the class.
Individual feedback on submissions from lecturer and/or demonstrators in laboratory sessions.

Failure Redemption: Resit exam and/or resubmit coursework as appropriate

Additional Notes:

Created September 2015. Available to visiting and exchange students

CSC079 Fundamentals of Robotics

Credits: 15 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr DR Sahoo

Format: Lab-based instruction.

Delivery Method: Lab-based instruction.

Module Aims: This module introduces students to the fundamentals of robotics. Students will demonstrate their ability to solve problems while developing their programming skills by completing a series of robotics-based lab tasks.

Module Content: Design and construction of robots using the LEGO Mindstorms EV3 Kit
Programming robotics kits in EV3 & MicroPython
Use of a variety of sensors (touch, gyroscope, ultrasonic, light)
Development of algorithms using sensors
Development and implementation of collision detection algorithms
Development and implementation of line-following algorithms

Intended Learning Outcomes: Students will understand and be able to apply basic engineering principles for system design, employing various computational problem-solving techniques.

Assessment: Examination (50%)
Coursework 1 (20%)
Coursework 2 (20%)
Laboratory work (10%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Standard Computer Science format unseen examination, duration 2hrs.

Two lab-based courseworks, the submissions of which being complete write-ups of the solutions to the problems solved (ie, explanation and evaluation of the design and implementation of a robot).

Continuous sequence of short lab tasks to be completed each week.

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Outline solutions provided along with group and individual analytical feedback for courseworks.
Examination feedback summarisiong strengths and weaknesses of the class.

Failure Redemption: Resit examination.

Additional Notes:

Available to visiting and exchange students.

EG-066 Basic Engineering Analysis 2

Credits: 20 Session: 2022/23 January-June

Pre-requisite Modules: EG-065

Co-requisite Modules:

Lecturer(s): Dr AJ Williams, Dr M Khalifa

Format: Synchronous lectures and example classes: 55 hours;
Direct private study: 145 hours;
Office hours in a weekly basis

Contact Hours will be delivered through a blend of live activities online and on-campus, and may include, for example, lectures, seminars, practical sessions and Academic Mentoring sessions.

Delivery Method: All Programmes will employ a blended approach to delivery using the Canvas Digital Learning Platform for live and self-directed online activity, with live and self-directed on-campus activities each week. Students may also have the opportunity to engage with online versions of sessions delivered on-campus

The delivery method will be a combination of pre-recorded lectures, online exercises, and example classes.

Module Aims: To provide grounding in engineering analysis methods for students without the background of A level mathematics. The module will extend the concepts covered in EG-065 to introduce some of the key mathematical techniques used in engineering. These will be related to common engineering systems.

Module Content: a) Inverse functions and graphical interpretation.

b) Binomial expansions.

c) Sequences and series: arithmetic, geometric, periodic and oscillating sequences, summation of series, Taylor series.

d) Differentiation: geometrical basis, definition and examples. Tangents and normal to curves. Differentiation of elementary functions, sums, products and quotients. Maxima and minima. Numerical differentiation techniques.

e) Integration: geometrical basis and basics of integral calculus. Areas, volumes of revolution, simple techniques of integration. Numerical integration techniques.

f) Newton Raphson method.

Intended Learning Outcomes: Technical outcomes:
After completing this module, the student should be able to demonstrate the following:
• The ability to determine inverse function algebraically and graphically (assessed by coursework 1 and examination)
• An ability to recognise, characterise and manipulate sequences and series (assessed by Coursework 1 and examination)
• The ability to expand binomial expressions (assessed by Coursework 2 and examination)
• The ability to differentiate common analytical functions (assessed by Courseworks 2-3, and examination)
• The ability to calculate maximum and minimum points (assessed by Courseworks 2-3 and examination)
• The ability to use implicit differentiation techniques (assessed by examination)
• The ability to use partial differentiation techniques (assessed by Coursework 4 and examination)
• The ability to integrate common analytical functions (assessed by Courseworks 4-5 and examination)
• The ability to calculate area and volume using integration (assessed by Coursework 4 and examination)
• An understanding of the graphical significance of integration and differentiation (assessed by Courseworks 2-4, and examination)
• The ability to apply numerical differentiation using Taylor series expansions (assessed by Coursework 3)
• The ability to apply numerical integration techniques (assessed by Coursework 5 and examination)
• An awareness of the differences between numerical and analytical methods (assessed by Courseworks 4-5, and examination)
• The ability to solve problems using multiple integrals (assessed by Coursework 5 and examination)
• The ability to use the Newton-Raphson method to solve equations (assessed by Coursework 3)
• The ability to use mathematical techniques to solve problems (thinking and problem interpretation skills) (assessed by Courseworks 1-5 and examination)

Accreditation Outcomes (AHEP):
- Knowledge and understanding of mathematical and statistical methods necessary to underpin their education in their engineering discipline and to enable them to apply mathematical and statistical methods, tools and notations proficiently in the analysis and solution of engineering problems (SM2b/SM2p) Assessed by Coursework's 1-5 and examination

Assessment:	Coursework 1 (10%) Coursework 2 (10%) Coursework 3 (10%) Coursework 4 (10%) Coursework 5 (10%) Examination 1 (50%)
Resit Assessment:	Examination (Resit instrument) (100%)

Assessment Description: Examination: A 2 hour closed book exam will take place in May/June (worth 50 % of the final mark).

Coursework: Electronic online tests with randomised coefficients will be set during the semester. These tests make up the coursework element of the course (worth 50% of the final mark). Each test is an individual piece of coursework.

This module is assessed by a combination of examination and coursework. In order for the coursework marks to count, you have to pass the exam component (with at least 40%). If you have less than 40% in the exam, then the module mark will be just the exam mark. Any resits are done by a supplementary exam. If you pass the exam but have failed the coursework, you may still fail the module, depending on the marks achieved, so it is important to do the coursework.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: Coursework feedback will be provided within 3-week after deadline according to University policy. When computer-based assignment the feedback will be done online and if required during lectures.

Exam: an examination feedback summary is available online to students.

Failure Redemption: A supplementary examination will form 100% of the module mark.

Additional Notes: Delivery of both teaching and assessment will be blended including live and self-directed activities online and on-campus.

Available to visiting and exchange students.

This module will be supported with Canvas.

Penalty for late submission of continuous assessment: zero tolerance.

This module is assessed by a combination of examination (50%) and coursework (50%). In order for the coursework marks to count, you have to pass the exam component (with at least 40%). If you have less than 40% in the exam, then the module mark will be just the exam mark. Any resits are done by a supplementary exam. If you pass the exam but have failed the coursework, you may still fail the module, depending on the marks achieved, so it is important to do the coursework.

Any resits are done by a supplementary exam.

MA-004 Fundamental Geometry

Credits: 15 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr Z Sobol

Format: 20 lectures
10 supervised exercise sessions

Delivery Method: Traditional lectures (2 per week) with supervised exercise sessions for individual work (1 per week).

Module Aims: This module introduces some essential geometric tools covering the basics of trigonometry, coordinate geometry, vectors and matrices.

Module Content: 1. TRIGONOMETRY
a. The definition and use of Radians.
b. The definitions of sin, cos, tan, sec, cosec and cot.
c. The sine and cosine rules.
d. Exact values of sin(), cos() and tan() for =0, /6, /4, /3, /2 etc.
e. The definitions of inverse trig functions.
f. Relationships between trig functions: tan = sin / cos , (sin())^2 + (cos())^2 = 1.
g. Formulas for sin(A±B), cos(A±B), tan(A±B).
h. Double and half angle formulas.
i. Expressions in the form: a cos(A)+b sin(A) = r cos(A+B) = r sin(A+C).
2. COORDINATE GEOMETRY IN 2 DIMENSIONS
a. Cartesian coordinates in the plane.
b. The geometry of a straight line: Gradient and intercept.
c. The equation of a line in the forms y = m x+c and (y – b) =m(x – a).
d. Conditions for two straight lines to be parallel or orthogonal.
e. The geometry of a circle: Properties including radius is orthogonal to tangent, angle in a semicircle is a right angle.
f. The Cartesian equation of a circle in the form (xa)^2 + (yb)^2=r^2.
g. Parametric representations of a circle in the form x = a+r cos(t), y = b+r sin(t).
3. POLAR COORDINATES
a. The definition of polar coordinates in the plane.
b. Transforming between Cartesian and polar coordinates.
c. Sketching a curve given in polar coordinates in the form r = f().
4. VECTORS IN 2 DIMENSIONS
a. Use of vectors to describe position and displacement between two points.
b. Vector addition, subtraction, multiplication by scalars (with geometric interpretation).
c. Calculating the magnitude of a vector.
5. 2x2 MATRICES
a. Addition, subtraction, multiplication by a scalar and multiplication of two matrices.
b. The zero and identity matrices.
c. The determinant and inverse.
d. Using a matrix to represent a geometric transformation (e.g. rotations, reflections of the plane).

Intended Learning Outcomes: i) The student will have a basic knowledge of geometry (triangle and circle).

ii) The student will have a knowledge of coordinate geometry and applications.

iii) The student will have a basic knowledge of vectors and matrices and their use in geometry.

iv) The student will be able to manipulate trigonometric functions using standard trigonometric identities.

Assessment: Examination (80%)
Coursework 1 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination: A written, closed-book examination at the end of the module.
Coursework 1: Three homework assignments during the semester, combined to give a single coursework mark.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work. For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.
Failure Redemption: Supplementary examination.
Additional Notes: Delivery of teaching will be on-campus. Continuous assessment will be submitted online. Available to visiting and exchange students

MA-006 Fundamental Mathematics

Credits: 15 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Dr I Rodionova

Format: 30 hours: This will be a mixture of sessions which may include for example: lectures, quizzes, exercises, examples classes.

Delivery Method: All programmes will employ a blended approach to delivery using the Canvas digital learning platform.

Module Aims: This module covers some important basic topics in mathematics introducing students to polynomials, functions, inequalities, sequences, series, exponentials and logarithms.

Module Content: 1. NUMBERS

a. Integers, rational numbers and real numbers. Brackets and BODMAS.
b. Fractions (addition, multiplication and division).
c. Revision of long division.
d. Square roots.

2. POLYNOMIALS

a. Quadratic polynomials: Graphs, quadratic formula, discriminant, concept of distinct and repeated real roots, completing the square.
b. Manipulation of general polynomials algebraically – laws of indices, expansion, factorisation.
c. Division of polynomials and partial fractions.
d. Use of the factor theorem to factorise a polynomial.
e. The binomial formula.

3. FUNCTIONS

a. Definition of a function, domain, range.
b. Composition of functions, inverse of a function.
c. Sketch the graph of some simple functions (e.g. straight line, quadratic polynomials, polynomials with known roots).
d. Simple transformations of functions and their graphs (e.g. given y=f(x) sketch y=af(x), y= f(x)+a, y=f(x+a), y= f(ax)).

4. SIMULTANEOUS EQUATIONS

a. Solving a system of linear equations by substitution.
b. Solving a pair of nonlinear equations (1 linear and 1 quadratic) by substitution.
c. Representing the solution of a system graphically.

5. INEQUALITIES

a. Solving linear and quadratic inequalities in one variable.
b. Represent linear and quadratic inequalities graphically.

6. SEQUENCES AND SERIES

a. Definition of a sequence.
b. Sequences explicitly and iteratively defined in the forms x(n) = f(n) and x(n+1) = f(x(n)).
c. Arithmetic and geometric sequences.
d. Definition of a series, sigma notation.

7. EXPONENTIALS AND LOGARITHMS

a. Functions of the form a^x. Graphing such functions.
b. Definition of e^x in terms of the gradient of its graph.
c. Definition of a general logarithm log_a(x) as the inverse of a^x and ln(x) as the inverse of e^x. Graphs of logarithms.
d. Properties of exponentials and logarithms: Formulas for products, powers and quotients of exponentials. Formulas for logarithms of products, powers and quotients. Formula for change of base in a logarithm.

Intended Learning Outcomes: i) The student should be able to perform simple algebraic manipulations of equations and expressions.

ii) The student should be able to find all of the real roots of a quadratic equation and know suitable techniques for finding roots of a general polynomial.

iii) The student should be able to solve a simple system of simultaneous equations using substitution.

iv) The student should be able to solve linear or quadratic inequalities in one variable.

v) The student should be able to perform calculations involving basic sequences and series.

vi) The student should be able to define the exponential function and the logarithm to a given base.

vii) The student should be able to use standard properties of exponentials and logarithms in the algebraic manipulation of expressions containing such terms.

Assessment: Examination 1 (80%)
Coursework 1 (20%)
Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination 1: An examination at the end of the module.
Coursework 1: formed of a number of coursework assignments along with participation in the module during the semester.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work.

For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.

Failure Redemption: Supplementary examination.

Additional Notes: Delivery of teaching will be on-campus. Continuous assessment will be submitted online.

Available to visiting and exchange students

MA-009 Computational Probability

Credits: 15 Session: 2022/23 September-January

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof IM Davies

Format: 10 Lectures: in-person, delivery, introducing and motivating current topic.

10 Laboratory sessions; 2 hour sessions, providing face-to-face support.
Office Hours will run in addition.

Delivery Method: The 1 hour lecture + 2 hour lab session delivery pattern will remain, along with the blended 'self-learning' as guided by the weekly structure on the Canvas site.

Module Aims: This module gives students an understanding of Monte Carlo methods, which use random simulation to computationally solve physical problems which may be difficult if not impossible to solve analytically. The delivery style of the module is very much tutorial in nature: only basic programming and probability theory will be taught and required, with the module concentrating on practical weekly lab-based problem-solving sessions.

The module material will consist of 'bite' sized presentations, and self-paced programming python notebooks.

Module Content: Basic Probability Theory:
- methods of counting (combinatorics);
- axioms of probability;
- sample spaces, events, and mutually exclusive events;
- the law of total probability;
- conditional probability and independence;

Basic Python Programming.
- variables, arrays, conditionals, loops, functions
- functions calculating commonly used statistics
- annotated histograms and boxplots for data sets
- simulation of coin flipping, dice rolling, and card drawing experiments
- creation of functions to calculate sampling possibilities in choosing k objects from n objects
- use of pseudo random numbers in simulating random walks and stock market behaviour
- implementation of Monte Carlo methods to illustrate the Law of Large Numbers and the Central Limit Theorem

Intended Learning Outcomes: At the end of the module students will
- know and be able to apply the theoretical concepts in probability theory, and statistics,
- be able to analyze computational problems in probability theory and design solutions for them,
- be able to implement and test their solutions in Python.

Assessment: Coursework 1 (20%)
Coursework 2 (20%)
Examination 1 (40%)
Laboratory work (20%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: The module will be assessed via continuous assessment and unseen examination.

Moderation approach to main assessment: Second marking as sampling or moderation

Assessment Feedback: Written and oral feedback will be given.

Failure Redemption: Examination resits.

Additional Notes: Delivery of teaching will be on-campus. Continuous assessment will be submitted online.

Available to visiting and exchange students

MA-010 Further Fundamental Mathematics

Credits: 10 Session: 2022/23 January-June

Pre-requisite Modules:

Co-requisite Modules:

Lecturer(s): Prof J Wu

Format: 20 lectures
10 supervised exercise sessions

Delivery Method: Traditional lectures (2 per week) with supervised exercise sessions for individual work (1 per week).

Module Aims: This module introduces students to complex numbers and ordinary differential equations.

Module Content: 1. COMPLEX NUMBERS
a. Definition and basic properties of the imaginary number. Real and imaginary parts.
b. Algebraic manipulation – addition, subtraction, multiplication of complex numbers.
c. The complex conjugate and modulus of a complex number.
d. Division by a complex number.
2. POLYNOMIALS
a. Revisiting the quadratic equation and the quadratic formula. Role of the discriminant for quadratic equations. Nature of roots.
b. Complex conjugate pairs of roots for general polynomials.
c. Factorising cubic equations with one real root.
3. GEOMETRY
a. The Argand diagram.
b. Argument and modulus of a complex number. Connection to polar coordinates.
c. Sketching curves in the complex plane e.g. arg(za)=, |z| = c.
4. DE MOIVRE'S THEOREM
a. Multiplication of complex numbers in the Argand diagram.
b. Statement of De Moivre's theorem.
c. Application to derivation of multiple angle formulae.
d. Finding the n roots of unity.
3. FIRST ORDER DIFFERENTIAL EQUATIONS
a. Concept of a differential equation. Differential equations from the real world e.g. population growth.
b. Separation of variables.
c. Using an integrating factor on an equation of the form $dy/dx + P(x)\, y = Q(x)$.
6. SECOND ORDER DIFFERENTIAL EQUATIONS.
a. Method of characteristic polynomial for second order homogeneous differential equations with constant coefficients. Standard forms for real, repeated and complex roots.

Intended Learning Outcomes: i) The student will be able to algebraically manipulate complex numbers.

ii) The student will understand the geometric interpretation of a complex number in terms of the Argand diagram.

iii) The student will be able to solve simple polynomial equations with complex roots.

iii) The student will be able to prove appropriate trigonometric identities using De Moivre's Theorem.

iv) The student will be able to solve simple first order differential equations.

v) The student will be able to solve homogeneous linear second order differential equations.

Assessment: Coursework 1 (20%)
Examination (80%)

Resit Assessment: Examination (Resit instrument) (100%)

Assessment Description: Examination: A written, closed-book examination at the end of the module.
Coursework 1: Three homework assignments during the semester, combined to give a single coursework mark.

Moderation approach to main assessment: Universal second marking as check or audit

Assessment Feedback: For the homework assignments, students will receive feedback in the form of marks, model solutions, overall feedback on the cohort performance, and some individual comments on their work. For the exam, students will receive feedback in the form of marks and overall feedback on the cohort performance. Further, individualised feedback, can be provided upon request.
Failure Redemption: Supplementary examination.
Additional Notes: Delivery of teaching will be on-campus. Continuous assessment will be submitted online.