[Foundation Calculus and Mathematical Techniques]
[CELEN037]

Module Handbook

Credits: [20]

This handbook contains important information about the module. Read it in full at the beginning of the semester and re-read it whenever you have a question. If you do not find an answer to your question here, contact the module convenor or your tutor.

Module convenor: Dr Chenyang Xue

chenyang.xue@nottingham.edu.cn

Contents

1. Who is teaching on this module?

Name	Role	Email	Room
Dr Sannia Mareta	Senior Tutor (Lecturer)	Sannia.Mareta2@nottingham.edu.cn	Trent 365
Dr Chenyang Xue	Convenor (Lecturer)	chenyang.xue@nottingham.edu.cn	Trent 341
Dr Richard Rankin	Lecturer	richard.rankin@nottingham.edu.cn	Trent 341
Dr Chenfei Zhang	Co-Convenor	chenfei.zhang@nottingham.edu.cn	Trent 341
Dr Collins Ezeh	Tutor	collins.ezeh@nottingham.edu.cn	Trent 365
Dr Stavros Mouslopoulos	Tutor	Stavros.Mouslopoulos@nottingham.edu.cn	Trent 365

Please check on Moodle for the Updated Office Hours.

2. What is this module about?

The Preliminary Year Mathematics Course consists of two modules:

(i) CELEN036 (Foundation Algebra for Physical Sciences and Engineering) in the Autumn Semester;

(ii) **CELEN037 (Foundation Calculus & Mathematical Techniques) in the Spring Semester.**

These modules, which form part of a compulsory core Preliminary Year Course, are designed to ensure that you have the mathematical skills and standard vocabulary which you will require when you embark on your full degree course next year. We hope to fill in any gaps in your knowledge and to introduce you to some of the features that you are likely to meet in degree programmes for engineering, science or computing.

The **CELEN037 (Foundation Calculus and Mathematical Techniques)** module provides a course to consolidate previous studies in differential calculus and

introduce a range of mathematical topics used in the analysis of problems in engineering and physical sciences. The module will cover techniques and applications of differentiation, integration, and differential equations. Application to solving real life problems is developed.

3. What will I learn on this module?

A student who completes this module successfully should be able to:

- Understand and use differential calculus of a function of a single variable.
- Use standard integration techniques and perform definite integration.
- Manipulate mathematical formulae, algebraic equations and standard functions.
- Apply fundamental mathematical concepts to problems of a routine nature in engineering or science.
- Construct and present mathematical arguments with accuracy and clarity.
- Communicate mathematical arguments using standard terminology.
- Reason logically and work analytically.
- Perform with high levels of accuracy.
- Use e-learning develop self-study skills.

This module consists of the following topics:

Introduction to derivatives; Finding derivatives of standard functions; Rules of differentiation and methods of finding derivatives of functions; Application of derivatives in optimization problems; Equations of tangent and normal lines; Newton-Raphson method of finding derivatives. Introduction to integration; Methods of integration; Definite integrals; Applications of integration in area and volume (of revolution) calculations; Numerical methods to estimate area. Ordinary Differential Equations (ODEs); Solving Variables-Separable form ODEs; Applications of ODEs; Maclaurin's series for the expansion of functions.

4. What are the learning activities on this module?

The Weekly Teaching Scheme for this module involves: Lecture (2 hours), Seminar (1 hour), Problem-solving class (1 hour), and Self-Study.

Lectures: There will be a 2 hours lecture every week of teaching which will be delivered in the DH Lawrence Auditorium (please check your timetable). Lecture summaries/slides will be uploaded to Moodle prior to the lecture so that students can come to the lecture sessions with some preparation.

Seminars: During every teaching week, there will be a seminar of 1 hour. Seminar Tutors will conduct the class in small groups providing help and encouraging discussions about questions in the seminar slides, these problems reinforce the concepts that have been treated in the lectures.

Problem-Solving Class: During every teaching week, there will be a problem-solving class of 1 hour. 2 Tutors will conduct the class in groups providing help and support students in problem solving.

Self-study: At UNNC we emphasise self-study. As such, for every 1 hour of lecture or seminar we expect that you will contribute around 4 hours towards reading and trying to understand the topics covered during the lecture session. You are encouraged to try and solve as many questions as you can on the Problem Sheet during self-study, and also refer to further exercises from any of the recommended texts.

Office Hours: You are encouraged to take advantage of Office hours offered by teaching staff, to get help on difficulties you may have with regard to lecture/seminar sessions or Problem Sheets. Information on the Office Hours are available on Moodle.

The schedule for the Lectures is given in the table below. Note that Timetable Week 30 is lecture and seminar free, but you would be expected to undertake some guided tasks as activities for this independent learning week. You may also use this opportunity to seek for additional support from tutors.

Timetable Week	Lecture	Topic
Week 23 (w/c 17 Feb. 2025)	1	An introduction to derivatives, Formal definition of the derivative, Derivatives of algebraic expressions, Derivatives of standard functions (trigonometric, exponential, and logarithmic). Rules of differentiation: sum/difference ($u \pm v$), product $u \cdot v$, Extension of the product rule, quotient rule for differentiation: u/v.
Week 24 (w/c 24 Feb. 2025)	2	Chain rule for derivatives of composite functions, Derivative of $y = x^x$, Logarithmic differentiation, Implicit functions and Implicit differentiation. Derivatives of an Inverse functions, Derivatives of Inverse trigonometric functions.
Week 25 (w/c 03 Mar. 2025)	3	Parametric differentiation, Higher order derivatives, McLaurin's series, Revisiting topics from coordinate geometry, Increasing, Decreasing and Constant functions, Equation of a tangent line, Newton-Raphson method, Increasing, Decreasing and Constant functions.
Week 26 (w/c 10 Mar. 2025)	4	Stationary and Critical points, Inflection and Turning points, Maximum and Minimum functions, Application of Derivatives (solving optimisation problems, problems on related rates).
Week 27 (w/c 17 Mar. 2025)	5	Introduction to Integration (Integration as an antiderivative, Integration as the area under a curve), Integration of standard functions. The method of substitution, some useful substitutions, trigonometric substitutions, Integrals of the form: $\int f(ax+b)dx$.
Week 28 (w/c 24 Mar. 2025)	6	Some useful results in integration, Integrating algebraic functions with square root in the denominator. The method of *t*-substitution, Integrals of the form: $\int \frac{1}{a\cos^2 x + b\sin^2 x + c} dx$
Week 29 (w/c 31 Mar. 2025)	7	Integration using Partial fractions, Integration by parts.
Week 30 (w/c 07 Apr. 2025)	**Independent Learning Week / Mid-Semester Examination**	
Week 31 (w/c 14 Apr. 2025)	8	Evaluating definite integrals, properties of definite integration, use of properties for evaluating definite integrals, the method of substitution for definite integration, method of partial fractions for definite integration, integration by parts for definite integration. Area calculation using definite integrals, Area of region bounded by two curves.
Week 32 (w/c 21 Apr. 2025)	9	Area calculation using definite integrals, Solid of revolution, calculating volume of solid of revolution using definite integration, Numerical Integration: Simpson's rule, Numerical Integration: Trapezoidal rule.
Week 33 (w/c 28 Apr. 2024)	10	Solving ordinary differential equations (ODEs) of variable-Separable form, Solving Initial value problems (IVP) of variable separable form, Solution of differential equations. Applications of differential equations to (exponential growth model, exponential decay model, Newton's law of cooling).
Week 34 (w/c 05 May 2024)	11	Revision lecture.

5. How is the module assessed?

The assessment information for this module is summarised in the table below:

Mid-Semester Exam	
Weighting	30% of overall module
Date set	9th April 2025, Wednesday of week 8. (60 minutes written examination) timetable would be released by CPSO and you would also be informed on Moodle.
Date submitted	N/A
Word count	N/A
Submitted via	As answer booklets collected after the examinations
Feedback	A complete working to all problems showing sample methods, and a statement of common errors made
Notes	• Students are expected to write their answers and show all workings to all questions in the space provided in the examination booklet which also contains all the questions. This would be collected after the examination. • Only CELE permissible calculators are allowed in this examination. • No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used. • Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted. **It may be necessary to move offline assessment online due to unforeseen circumstances.**

End of Semester Exam	
Weighting	70% of overall module
Date and Time	Scheduled during University Exam Weeks
Duration	90 minutes
Topics	**Q.1**: Differentiation (Definition, Rules, Implicit, Inverse) **Q.2**: Differentiation (Parametric, Logarithmic), Application of derivatives (Tangent and Normal lines, Increasing and decreasing functions, Related rates) **Q.3**: Application of derivatives (Stationary points, derivative tests, optimization problems, Newton Raphson method), Higher order derivatives

	Q.4: Maclaurin's series, Simple integration (including simple substitutions) **Q.5**: Integration by substitution (including trigonometric substitution), results (e.g. $\int \frac{f'(x)}{f(x)}dx$, $\int e^x\big(f(x)+f'(x)\big)dx$), Integrating algebraic fractions, t-substitution **Q.6**: Techniques of Integration (partial fractions, parts, including definite integrals), Applications of integration (Area, volume of solid of revolution), Numerical integration methods **Q.7**: Order and Degree of ODEs, Solving V-S form ODEs, IVPs, Formation of ODE, Solutions of ODE, Applications of ODE
Type of assessment	Onsite
Feedback	A complete working to all solutions showing sample methods, and a statement of common errors made
Notes	• Only CELE permissible calculators are allowed in this examination. • No electronic devices capable of storing and retrieving text, including electronic dictionaries, may be used. • Dictionaries are not allowed with one exception. Those whose first language is not English may use a standard translation dictionary to translate between that language and English provided that neither language is the subject of this examination. Subject specific translation dictionaries are not permitted. • **It may be necessary to move offline assessment online due to unforeseen circumstances.**

6. What are the assessment criteria?

You would be expected to show all workings to all the questions, and the marks awarded are based on your workings. Check the Moodle page few weeks before the mid-semester examination and final examinations to see sample questions, answers, and marking scheme which would be made available to aid your preparation.

7. What do I need to know about feedback?

Feedback to the answers to worksheet questions used for the seminar would be discussed by tutors in the succeeding seminar sessions. For the mid-semester examination, a complete working together with the marking scheme would be provided immediately after the exam on Moodle (this would aid your preparation for the final examination). Also, after the final examination, a statement of the common errors made would be published on Moodle.

Please, make use of the office hours and drop-in sessions to further discuss general feedbacks with tutors.

8. Where can I find the module readings and materials?

All information and materials for this module are available on its Moodle Page.

The Moodle page contains constantly updated information relating to this module, and all the relevant Learning Materials.

The **Learning Materials** on Moodle are: Lecture Slides, Seminar Slides, Problem Sheets, MathTutor resources, and Vocabulary materials.

Lecture Slides: These are the slides used to deliver the weekly lectures. A summary of this slide would be available on Moodle before every lecture, you can use this for prior preparation before the lecture. The complete version of the lecture slide would be uploaded on Moodle after every lecture.

Seminar Slides: These are the slides used to deliver the weekly seminars. A copy of these slides is made available on Friday by 6 pm after all seminars must have been conducted.

Seminar Worksheets: These are the worksheets used during the seminars. It would be uploaded on Moodle starting from Week 24. You are expected to bring this to the seminar (but do not solve the questions in them), rather, you can use the problem sheets to practice after the lectures.

Problem Sheets: This is a collection of problems relating to the topics treated in that week. The answers to the exercises are provided, and it is expected that you use this resource for additional practice.

Vocabulary Materials: These are a collection of resources to help you with some important vocabulary for this module.

Mathcentre and HELM Resources: This is a provision for web-based interactive materials to enable students to revise and practice basic mathematical skills. It comprises summary text and exercises. The learning material is produced by a group of teachers and mathematicians from some UK Universities: Mathcentre, HELM.

Additional Reading for this Module

Reference textbook: Calculus by G. B. Thomas Jr, as revised by J. Hass & others. (15th edition in SI Units). Publisher: Pearson. You may access this textbook on NUSearch. Note that there are limited access to this e-book at any given time, as such you may have to wait for a while to gain access.

Other reference textbooks: There are few quantities of physical copies or limited electronic access to the digital copies of some of these textbooks in the University Library.

Foundation Calculus by P. Gajjar. Publisher: Red Globe Press.

Engineering Mathematics by K. A. Stroud & D. J. Booth. Publisher: Palgrave Macmillan.

Foundations of Mathematics by P. Brown. Publisher: Mercury Learning & Information.

9. What happens if I fail?

Resits for the module comprises a written examination (with 100% weighting) taken within the University period of resit examinations, provisionally scheduled for August 2025.

10. Other important information about this module

Formula Sheet: The attached formula sheet (last two pages of this booklet) is standard for this course and will be provided during the written examination, and can always be used for reference during seminars or self-study.

Calculator: The university approved calculator is the CASIO fx-82 family of calculators (shown below), it is required that you use this during any written examination for this module. Note that further information on how to ensure that your calculator is an approved calculator would be given during the semester prior to the end-of-year examination.

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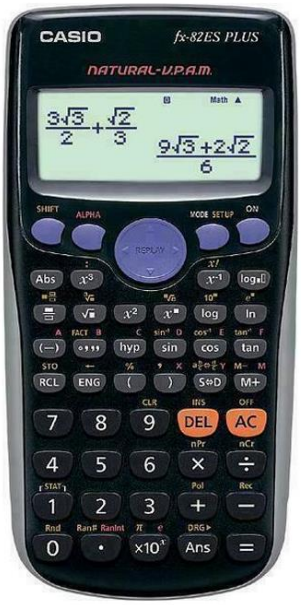

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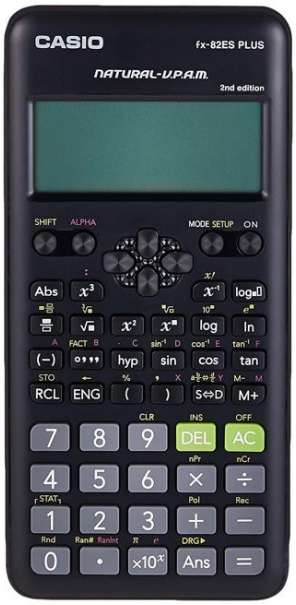

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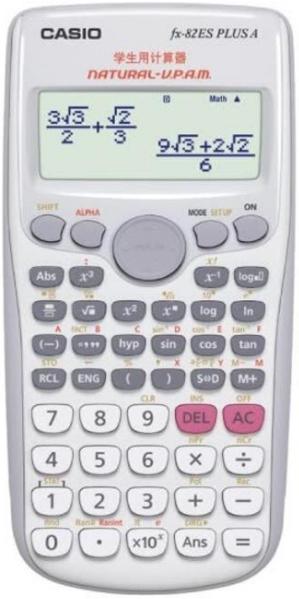

11. Important policies to know

Academic misconduct

There is **zero tolerance** of Academic Misconduct for all students studying at UNNC. Once academic misconduct is confirmed, it will result in appropriate penalties. Misconduct is any inappropriate activity or behaviour by a student which may give that student, or another student, an unpermitted academic advantage in marked assessment. This includes (and is not limited to) plagiarism (appropriating someone else's texts or ideas without proper referencing), asking someone else to complete one's assessments, sharing your answers to individual quizzes with other students.

Misconduct Policy:
https://www.nottingham.edu.cn/en/academicservices/academic-misconduct/academic-misconduct.aspx

Misconduct Procedure (UNNC):
https://www.nottingham.edu.cn/en/academicservices/academic-misconduct/academic-misconduct.aspx

Extenuating Circumstances (EC)

If you **miss an exam or other form of assessment** on medical or acute personal grounds, please follow the procedures to apply for EC.

Extenuating Circumstances Procedure (UNNC):

https://www.nottingham.edu.cn/en/academicservices/unnc-extenuating-circumstances-procedure/unnc-extenuating-circumstances-procedure.aspx

Attendance policy

Please remember that **all classes are compulsory.** If you have to ask for leave you need to contact The Hub via TheHub@nottingham.edu.cn and provide evidence. Missing classes without authorized reasons will be recorded as **Absence** which may jeopardize your study.
A copy of the policy is posted here along with other useful documents:

https://moodle.nottingham.ac.uk/mod/folder/view.php?id=1738700

If any of these links results broken, you can contact CPSO for assistance:

cpso@nottingham.edu.cn.

AI policy

Students on this module are expected to abide by the **UNNC Artificial Intelligence Student Use Policy**. It is the student's responsibility to familiarise themselves with the policy and seek clarification from the Module Convenor if in doubt. Failure to comply with the policy can be considered academic misconduct and may result in disciplinary action according to the University of Nottingham Quality Manual.