MA137-24 Mathematical Analysis

21/22

Department
Warwick Mathematics Institute
Level
Undergraduate Level 1
Module leader
Ian Melbourne
Credit value
24
Module duration
20 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

Many problems in mathematics cannot be solved explicitly. So one resorts to finding approximate solutions and estimate the error between a true solution and the approximate one. Indeed, one may even be able to demonstrate the existence of a solution by exhibiting a sequence of approximate solutions that converge to an exact solution.
The study of limiting processes is the central theme in mathematical analysis. It involves the quantification of the notion of limit and precise formulation of intuitive notions of infinite sums, functions, continuity and the calculus.
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.

Module web page

Module aims

By the end of the module the student should be able to:
Understand what is meant by the symbol 'infinity'
Understand what it means for a sequence to converge or diverge and to compute simple limits
Determine when it makes sense to add up infinitely many numbers
Understand the notions of continuity and differentiability

Establish various properties of continuous and differentiable functions
Answer the question "when can a function be represented by a power series?"
Develop their own methods for solving problems

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

1. Decimal expressions and real numbers; the geometric series and conversion of recurring decimals into fractions.
2. Convergence of a nonrecurring decimal and the completeness axiom in the form that an increasing sequence which is bounded above converges to a real number.
3. The completeness axiom as the main distinguishing feature between the rationals and the reals; approxiamtion of irrationals by rationals and vice-versa.
4. Inequalities.
5. Formal definition of sequence and subsequence.
6. Limit of a sequence of real numbers; Cauchy sequences and the Cauchy criterion.
7. Series:
   (a) Series with positive terms
   (b) Alternating series
8. The number e both as lim(1+(1/n))^n and as 1 + 1 + (1/2!) + (1/3!) + ...
9. Bounded and unbounded sets. Sups and infs.
10. Continuity
11. Properties of continuous functions
12. Continuous Limits
13. Differentiability
14. Properties of differentiable functions
15. Higher order derivatives
16. Power Series
17. Taylor’s Theorem
18. The Classical Functions of Analysis
19. Upper and Lower Limits

Learning outcomes

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

- Understand what is meant by the symbol `infinity'
- Understand what it means for a sequence to converge or diverge and to compute simple limits
- Determine when it makes sense to add up infinitely many numbers
- Understand the notions of continuity and differentiability
- Establish various properties of continuous and differentiable functions
- Answer the question "when can a function be represented by a power series?"
- Develop their own methods for solving problems

Indicative reading list

D. Stirling, Mathematical Analysis and Proof, 1997.
M. Spivak, Calculus, Benjamin.
M. Hart, Guide to Analysis, Macmillan. (A good traditional text with theory and many exercises.)
G.H. Hardy, An introduction to Pure Mathematics, CUP.

Subject specific skills

See learning outcomes

Transferable skills

Students will acquire key reasoning and problem solving skills which will empower them to address new problems with confidence.

Study

Study time

Type	Required
Lectures	60 sessions of 1 hour (25%)
Seminars	18 sessions of 30 minutes (4%)
Private study	171 hours (71%)
Total	240 hours

Private study description

171 hours private study, revision for exams, and non-assessed assignments

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group D3

	Weighting	Study time
Weekly Assignments	15%	
In-person Examination	60%	

- Answerbook Pink (12 page)

Online Examination	25%	

- Online examination: No Answerbook required

Assessment group R

	Weighting	Study time
In-person Examination - Resit exam	100%	

- Answerbook Pink (12 page)

Feedback on assessment

Assignments marked by supervisors, typically returned within one week.

Past exam papers for MA137

Availability

Courses

This module is Core for:

- USTA-G302 Undergraduate Data Science
  - Year 1 of G302 Data Science
  - Year 1 of G302 Data Science
- Year 1 of USTA-G304 Undergraduate Data Science (MSci)
- UCSA-G4G1 Undergraduate Discrete Mathematics
  - Year 1 of G4G1 Discrete Mathematics
  - Year 1 of G4G1 Discrete Mathematics
- Year 1 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 1 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- UMAA-GV17 Undergraduate Mathematics and Philosophy

    - Year 1 of GV17 Mathematics and Philosophy
    - Year 1 of GV17 Mathematics and Philosophy
    - Year 1 of GV17 Mathematics and Philosophy
- Year 1 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
    - Year 1 of GF13 Mathematics and Physics
    - Year 1 of GF13 Mathematics and Physics
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 1 of FG31 Mathematics and Physics (MMathPhys)
    - Year 1 of FG31 Mathematics and Physics (MMathPhys)
- Year 1 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
    - Year 1 of GG14 Mathematics and Statistics
    - Year 1 of GG14 Mathematics and Statistics
- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
    - Year 1 of Y602 Mathematics,Operational Research,Stats,Economics
    - Year 1 of Y602 Mathematics,Operational Research,Stats,Economics