

MA241-12 Combinatorics

21/22

Department

Warwick Mathematics Institute

Level

Undergraduate Level 2

Module leader

Rob Silversmith

Credit value

12

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

N/A

[Module web page](#)

Module aims

N/A

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.

I Enumerative combinatorics

-Basic counting (Lists with and without repetitions, Binomial coefficients and the Binomial Theorem)

-Applications of the Binomial Theorem (Multinomial Theorem, Multiset formula, Principle of inclusion/exclusion)

-Linear recurrence relations and the Fibonacci numbers

-Generating functions and the Catalan numbers

-Permutations, Partitions and the Stirling and Bell numbers

II Graph Theory

-Basic concepts (isomorphism, connectivity, Euler circuits)

-Trees (basic properties of trees, spanning trees, counting trees)

-Planarity (Euler's formula, Kuratowski's theorem, the Four Colour Problem)

-Matching Theory (Hall's Theorem and Systems of Distinct Representatives)

-Elements of Ramsey Theory

III Boolean Functions

Learning outcomes

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

- N/A

Indicative reading list

Edward E. Bender and S. Gill Williamson, Foundations of Combinatorics with Applications, Dover Publications, 2006. Available online at the author's website:

<http://www.math.ucsd.edu/~ebender/CombText/>

John M. Harris, Jeffry L. Hirst and Michael J. Mossinghoff, Combinatorics and graph theory, Springer-Verlag, 2000.

Subject specific skills

N/A

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	30 sessions of 1 hour (25%)
Tutorials	9 sessions of 1 hour (8%)
Private study	81 hours (68%)
Total	120 hours

Private study description

Review lectured material and work on set exercises.

Costs

No further costs have been identified for this module.

Assessment

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

Assessment group D1

	Weighting	Study time
Assignments 4 fortnightly assignments during the term.	10%	
In-person Examination	90%	
<ul style="list-style-type: none">• Answerbook Pink (12 page)		

Assessment group R

	Weighting	Study time
In-person Examination - Resit	100%	
<ul style="list-style-type: none">• Answerbook Pink (12 page)		

Feedback on assessment

Marked assignments and exam feedback.

[Past exam papers for MA241](#)

Availability

Courses

This module is Core for:

- UCSA-G4G1 Undergraduate Discrete Mathematics
 - Year 2 of G4G1 Discrete Mathematics
 - Year 2 of G4G1 Discrete Mathematics

- Year 2 of UCSA-G4G3 Undergraduate Discrete Mathematics

This module is Optional for:

- Year 2 of UCSA-I1N1 Undergraduate Computer Science with Business Studies
- USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
 - Year 3 of G300 Mathematics, Operational Research, Statistics and Economics
 - Year 4 of G300 Mathematics, Operational Research, Statistics and Economics
- Year 4 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
 - Year 2 of G1G3 Mathematics and Statistics (BSc MMathStat)
 - Year 3 of G1G3 Mathematics and Statistics (BSc MMathStat)
- USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
 - Year 4 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
 - Year 5 of G1G4 Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
 - Year 2 of GG14 Mathematics and Statistics
 - Year 2 of GG14 Mathematics and Statistics
- USTA-Y602 Undergraduate Mathematics, Operational Research, Statistics and Economics
 - Year 2 of Y602 Mathematics, Operational Research, Stats, Economics
 - Year 2 of Y602 Mathematics, Operational Research, Stats, Economics

This module is Core option list A for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
 - Year 2 of GV17 Mathematics and Philosophy
 - Year 2 of GV17 Mathematics and Philosophy
 - Year 2 of GV17 Mathematics and Philosophy
- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list B for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
 - Year 3 of GV17 Mathematics and Philosophy
 - Year 3 of GV17 Mathematics and Philosophy
 - Year 3 of GV17 Mathematics and Philosophy
- UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations
 - Year 3 of GV19 Mathematics and Philosophy with Specialism in Logic and Foundations
 - Year 3 of GV19 Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list C for:

- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list D for:

- Year 4 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Option list A for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercolated Year)
 - Year 2 of G105 Mathematics (MMath) with Intercolated Year
 - Year 3 of G105 Mathematics (MMath) with Intercolated Year
- UMAA-G100 Undergraduate Mathematics (BSc)
 - Year 2 of G100 Mathematics
 - Year 2 of G100 Mathematics
 - Year 2 of G100 Mathematics
 - Year 3 of G100 Mathematics
 - Year 3 of G100 Mathematics
 - Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
 - Year 2 of G100 Mathematics
 - Year 2 of G103 Mathematics (MMath)
 - Year 2 of G103 Mathematics (MMath)
 - Year 3 of G100 Mathematics
 - Year 3 of G103 Mathematics (MMath)
 - Year 3 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
 - Year 2 of G106 Mathematics (MMath) with Study in Europe
 - Year 3 of G106 Mathematics (MMath) with Study in Europe
- Year 2 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 2 of UMAA-G1N2 Undergraduate Mathematics and Business Studies (with Intercolated Year)
- Year 2 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 2 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercolated Year)
- Year 3 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)
- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
 - Year 3 of GF13 Mathematics and Physics
 - Year 3 of GF13 Mathematics and Physics
- UMAA-G101 Undergraduate Mathematics with Intercolated Year
 - Year 2 of G101 Mathematics with Intercolated Year
 - Year 4 of G101 Mathematics with Intercolated Year

This module is Option list B for:

- UCSA-G500 Undergraduate Computer Science
 - Year 2 of G500 Computer Science
 - Year 2 of G500 Computer Science
- UCSA-G503 Undergraduate Computer Science MEng
 - Year 2 of G500 Computer Science
 - Year 2 of G503 Computer Science MEng

- Year 2 of G503 Computer Science MEng
- Year 2 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
 - Year 3 of GG14 Mathematics and Statistics
 - Year 3 of GG14 Mathematics and Statistics
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)
- USTA-Y602 Undergraduate Mathematics, Operational Research, Statistics and Economics
 - Year 2 of Y602 Mathematics, Operational Research, Stats, Economics
 - Year 2 of Y602 Mathematics, Operational Research, Stats, Economics
 - Year 3 of Y602 Mathematics, Operational Research, Stats, Economics
 - Year 3 of Y602 Mathematics, Operational Research, Stats, Economics
- Year 4 of USTA-Y603 Undergraduate Mathematics, Operational Research, Statistics, Economics (with Intercalated Year)

This module is Option list E for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated
 - Year 3 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
 - Year 4 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)