

# MA241-12 Combinatorics

**23/24**

**Department**

Warwick Mathematics Institute

**Level**

Undergraduate Level 2

**Module leader**

Rob Silversmith

**Credit value**

12

**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 (77%)
Tutorials	9 sessions of 1 hour (23%)
Total	39 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"><li>• Answerbook Pink (12 page)</li></ul>		

### Assessment group R

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

## Feedback on assessment

Marked assignments and exam feedback.

[Past exam papers for MA241](#)

---

## Availability

## Courses

This module is Optional for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- Year 4 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 4 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

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

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:

- UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year
  - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year
  - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year

This module is Option list A for:

- Year 3 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- 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 3 of UPXA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)

This module is Option list B for:

- 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 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)