MA3P2-15 Knot Theory

26/27

Department
Warwick Mathematics Institute
Level
Undergraduate Level 3
Module leader
Mark Cummings
Credit value
15
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

A knot may be regarded as a continuous loop of (thin rubber) string. There are two fundamental problems: Is the loop really knotted? When is a loop attainable from another by continuous deformation?

The problem is tackled by computing invariants. If for instance we have a computable way to assign invariant numbers to knots then two knots with different numbers cannot be equivalent. Another approach is to look at the topology of the complement of the knot. Can we find a surface with the knot as boundary? What properties does it have?

Module web page

Module aims

To enable students to understand the concepts of knots and ways to represent them on the page. We explore various properties of knots and their diagrams, and use these to define several knot invariants; we will consider the properties of these invariants and use them to distinguish knots.

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.

Introduction of knots and knot diagrams
Reidemeister moves
Knot colourings and colouring groups
The Alexander Polynomial
Braids and Braid groups
Seifert circles
The Jones Polynomial
The Conway Polynomial

Learning outcomes

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

- Understand the definition of a knot and draw knot diagrams
- Understand the theory about, and be able to calculate, colouring numbers of knots, as well as colouring groups
- Understand the theory about, and be able to calculate, the Alexander, Jones, and Conway Polynomials for knots
- Understand how knots can be represented using bridges, plats, and braids,

Indicative reading list

Reading lists can be found in Talis

Specific reading list for the module

Subject specific skills

Ability to draw knots and apply Reidemeister moves.
Knowledge of, and ability to calculate and apply, knot invariants.
Ability to represent knots using braids, and to obtain Seifert circles.

Transferable skills

Students will develop their ability to work with abstract concepts, and to explore the use of various tools to distinguish objects.

Study

Study time

Type	Required	Optional
Lectures	30 sessions of 1 hour (20%)	
Seminars	(0%)	9 sessions of 1 hour
Private study	120 hours (80%)	
Total	150 hours	

Private study description

Reviewing notes, non-assessed assignment sheets, support classes, revision

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Assessment group B

	Weighting	Study time	Eligible for self-certification
Assessment component			
Centrally-timetabled examination (On-campus) • Answerbook Gold (24 page)	100%		No
Reassessment component is the same			

Feedback on assessment

Final grade

Past exam papers for MA3P2

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
    - Year 1 of G1PC Mathematics (Diploma plus MSc)
    - Year 2 of G1PC Mathematics (Diploma plus MSc)
- Year 3 of UCSA-G4G1 Undergraduate Discrete Mathematics
- UCSA-G4G3 Undergraduate Discrete Mathematics
    - Year 3 of G4G1 Discrete Mathematics
    - Year 3 of G4G3 Discrete Mathematics
- Year 4 of UCSA-G4G4 Undergraduate Discrete Mathematics (with Intercalated Year)
- Year 4 of UCSA-G4G2 Undergraduate Discrete Mathematics with Intercalated Year

This module is Core option list C for:

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

This module is Core option list F 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 Intercalated Year)
    - Year 4 of G105 Mathematics (MMath) with Intercalated Year
    - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- Year 3 of UMAA-G100 Undergraduate Mathematics (BSc)
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G100 Mathematics
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- Year 4 of UMAA-G107 Undergraduate Mathematics (MMath) with Study Abroad
- Year 3 of UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
- UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
    - Year 3 of GF13 Mathematics and Physics
    - Year 3 of FG31 Mathematics and Physics (MMathPhys)
- Year 4 of UPXA-GF14 Undergraduate Mathematics and Physics (with Intercalated Year)
- Year 4 of UMAA-G101 Undergraduate Mathematics with Intercalated Year