MA4H8-15 Ring Theory

22/23

Department
Warwick Mathematics Institute
Level
Undergraduate Level 4
Module leader
Marco Schlichting
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

We aim to study noncommutative rings with chain conditions. A commutative integral domain has a (unique) field of fractions. What happens if we drop the commutativity axiom? Do we now obtain a division ring of fractions? If not always then when exactly? Do we need to differentiate between the left hand side and the right hand side of the ring? Also, does the theory extend meaningfully to rings such as rings of matrices which contain zero divisors? We shall give precise answers to all these questions.
Topics covered in pursuit of the above will include prime and semiprime rings, Artinian rings, composition series, the singular submodule, Ore's theorem leading up to Goldie's theorems and their applications.

Module web page

Module aims

Non-commutative ring theory is a fundamental part of algebra with a relationship with geometry and representation theory. A student taking this module will experience algebra at an advanced level and this course will provide a solid background to anyone contemplating research in a branch of algebra. In particular, some relatively recent results will be proved.

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.

Irreducible modules, completely reducible modules, chain conditions, composition series

‘Nil implies nilpotent’ theorems. Hopkins’s theorem that DCC implies ACC for rings

Uniform modules, Goldie dimension, complements, rings of quotients, Ore’s theorem, Goldie’s theorem, Artinian quotient rings, behaviour of prime ideals in rings of quotients

The Jacobson radical, fully bounded Noetherian rings, The
Jacobson conjecture

Learning outcomes

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

- The knowledge and understanding that a student will be expected to have upon completion, such as : ‘a theoretical knowledge of the principles and methods of archaeology’ or ‘a knowledge of the major types of chemical reaction and the main characteristics associated with them.’
- Communication (written, verbal, graphical...) Numeracy Use of information technology (e.g. WP, www, databases, spreadsheets, specialist packages) Ability to learn Others (e.g. teamwork)
- (c) Cognitive Skills For example: ability in critical analysis; the ability to formulate and test concepts and hypotheses.
- (d) Subject-Specific/Professional Skills For example: laboratory skills; scientific support writing; research skills and methods.

Indicative reading list

A.W.Chatters and C.R.Hajarnavis, Rings with chain conditions (QA251.5.C4)
K.R.Goodearl and R.B.Warfield,Jr., An introduction to noncommutative Noetherian Rings (QA251.5.G6)
J.C.McConnell and J.C.Robson, Noncommutative Noetherian rings (QA251.5M2)
N.H.McCoy, Rings and ideals (QA247.M33)
L.H.Rowen, Ring Theory (QA247.R68)

Subject specific skills

Ring theory applies among others to systems of numbers and matrices. Students get training in applying an axiom in set theory to deal with infinite sets which occur in algebra. The knowledge they acquire in MA377 is extended and deeper results on rings and modules are proved. They learn how to generalise the concept of fractions leading to acquaintance with modern results on rings of quotients.

Transferable skills

Students will acquire skills to solve complex problems in algebra. This will be valuable in careers such as teaching or research. They will have sufficient supporting knowledge to begin postgraduate work in algebra, geometry or representation theory.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	9 sessions of 1 hour (6%)
Private study	111 hours (74%)
Total	150 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.

Students can register for this module without taking any assessment.

Assessment group B2

	Weighting	Study time
In-person Examination	100%	

- Answerbook Gold (24 page)

Assessment group R1

	Weighting	Study time
In-person Examination - Resit	100%	

- Answerbook Gold (24 page)

Feedback on assessment

Marked coursework and exam feedback.

Past exam papers for MA4H8

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-G1PE Master of Advanced Study in Mathematical Sciences
- 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

This module is Option list A for:

- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 5 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list B for:

- TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
  - Year 1 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
  - Year 2 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- 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 Option list C 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
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- Year 4 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe

This module is Option list E for:

- Year 4 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- Year 5 of USTA-G301 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics (with Intercalated