MATH338

Algebra IIIB

S2 Day 2018

Dept of Mathematics

Contents

General Information

Unit convenor and teaching staff
Lecturer
Michael Batanin
michael.batanin@mq.edu.au
Contact via by email or 0409073877
E7A309
Fri 1-2 or by appointment

Rod Yager
rod.yager@mq.edu.au

Credit points
3

Prerequisites

Corequisites
MATH337

Co-badged status

Unit description
This unit further develops the theory of algebraic structures commenced in MATH337, and involves the study of a selection of topics in field theory as well as a study of algorithms used in the application of linear algebra to the practical computational solution of real-world problems. The field theory strand develops the basic theory, including the notion of irreducibility of polynomials, simple, algebraic and transcendental extensions, and the tower law. The ideas of group theory studied in MATH337 are then applied to the study of field extensions via the notion of automorphisms, culminating in the study of the Galois correspondence theorem. The numerical linear algebra strand focuses on the study of large matrices and the use of matrix decomposition techniques appropriate to the computation of approximate solutions of the kinds of differential equations with specified boundary conditions that commonly arise in problems in science and engineering.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

On successful completion of this unit, you will be able to:

Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.
Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.
Work effectively, responsibly and safely in an individual context.

General Assessment Information

- HURDLES: This unit has no hurdle requirements. This means that there are no second chance examinations and assessments if you happen to fail at your first attempt. Students should aim to get at least 60% for the course work in order to be reasonably confident of passing the unit. IMPORTANT: If you receive special consideration for the final exam, a supplementary exam will be scheduled in the interval between the regular exam period and the start of the next session. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. You can check the supplementary exam information page on FSE101 in iLearn (bit.ly/FSESupp) for dates, and approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1	10%	No	see iLearn

Name	Weighting	Hurdle	Due
Assignment 2	10%	No	see iLearn
Assignment 3	10%	No	see iLearn
Project	10%	No	see iLearn
Final examination	60%	No	University Examination Period

Assignment 1

Due: **see iLearn**
Weighting: **10%**

Assignment based on both components of the unit.

On successful completion you will be able to:

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.
- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.
- Work effectively, responsibly and safely in an individual context.

Assignment 2

Due: **see iLearn**
Weighting: **10%**

Assignment based on both components of the unit.

On successful completion you will be able to:

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.
- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.
- Work effectively, responsibly and safely in an individual context.

Assignment 3

Due: **see iLearn**
Weighting: **10%**

Assignment based on both components of the unit.

On successful completion you will be able to:

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.
- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.

- Work effectively, responsibly and safely in an individual context.

Project

Due: **see iLearn**
Weighting: **10%**

In this project the student will apply the techniques of Galois to the study of two specific polynomial equations.

On successful completion you will be able to:

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.
- Work effectively, responsibly and safely in an individual context.

Final examination

Due: **University Examination Period**
Weighting: **60%**

-
On successful completion you will be able to:

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.
- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.

Delivery and Resources

Classes

Lectures: you should attend two hours of each lecture stream each week, making a total of four

hours.

Required and Recommended Texts and/or Materials

The required text for the Galois Theory part of MATH338 is Ian Stewart, *Galois Theory* Chapman and Hall 4th Edition. Lecture notes will be provided for the Advanced Linear Algebra part of MATH338.

ADDITIONAL TEXTS

Galois Theory

- John A. Beachy, *Introductory Lectures on Rings and Modules* Cambridge 1999.
- Harold M. Edwards, *Galois Theory* Springer, 1984, Graduate Texts in Mathematics 101 (written in the spirit of "Read the masters!", there is a definite attempt to expose Galois' original ideas).
- Emil Artin, *Galois Theory* Notre Dame Mathematical Lectures 2, 1959 (the pithy work of a master - very thin).
- Francis Borceux and George Janelidze, *Galois Theories* Cambridge Studies in Advanced Mathematics 72, 2001 (the early sections are appropriate for this unit; the keen student can then find how Galois' ideas have developed in recent times).
- Tom Petsinis, *The French Mathematician, A Novel* Penguin, 1997 (non-technical novel written in the first person as Galois, sets the historical stage for Galois' work; a fun read of a sad tale!).

Advanced Linear Algebra

- Gilbert Strang, *Linear Algebra and its Applications* Brooks/Cole, 1988 (contains useful supporting material, but too elementary for this course).
- B. Hartley and T.O. Hawkes, *Rings, Modules, and Linear Algebra,* Chapman and Hall.

Technology Used and Required

Students are expected to have access to an internet enabled computer with a web browser and Adobe Reader software. Several areas of the university provide wireless access for portable computers. There are computers for student use in the Library.

Difficulties with your home computer or internet connection do not constitute a reasonable excuse for lateness of, or failure to submit, assessment tasks.

Unit Schedule

Learning and Teaching Activities

Lectures

four lectures per week

assessment tasks

see assessment tasks

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results shown in *iLearn*, or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au.

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Capable of Professional and Personal Judgement and Initiative

We want our graduates to have emotional intelligence and sound interpersonal skills and to demonstrate discernment and common sense in their professional and personal judgement. They will exercise initiative as needed. They will be capable of risk assessment, and be able to handle ambiguity and complexity, enabling them to be adaptable in diverse and changing environments.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of

Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.
- Work effectively, responsibly and safely in an individual context.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Commitment to Continuous Learning

Our graduates will have enquiring minds and a literate curiosity which will lead them to pursue knowledge for its own sake. They will continue to pursue learning in their careers and as they participate in the world. They will be capable of reflecting on their experiences and relationships with others and the environment, learning from them, and growing - personally, professionally and socially.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating

deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Apply mathematical principles, concepts, techniques, and technology to solve practical and abstract problems in Galois Theory and Advanced Linear Algebra.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3

- Project
- Final examination

Learning and teaching activities

- see assessment tasks

Engaged and Ethical Local and Global citizens

As local citizens our graduates will be aware of indigenous perspectives and of the nation's historical context. They will be engaged with the challenges of contemporary society and with knowledge and ideas. We want our graduates to have respect for diversity, to be open-minded, sensitive to others and inclusive, and to be open to other cultures and perspectives: they should have a level of cultural literacy. Our graduates should be aware of disadvantage and social justice, and be willing to participate to help create a wiser and better society.

This graduate capability is supported by:

Learning outcomes

- Demonstrate a well-developed knowledge of the principles, concepts, and techniques of Galois Theory and Advanced Linear Algebra.
- Demonstrate an understanding of the breadth of Galois Theory and Advanced Linear Algebra, their multi-disciplinary role, and the way they contribute to the development of the mathematical sciences.
- Construct logical, clearly presented and justified mathematical arguments incorporating deductive reasoning as applied to Galois Theory and Advanced Linear Algebra.
- Appropriately interpret information concerning Galois Theory and Advanced Linear Algebra communicated in a wide variety of forms.
- Appropriately present ideas, information, reasoning, and conclusions concerning Galois Theory and Advanced Linear Algebra in forms tailored to the needs of diverse audiences.
- Work effectively, responsibly and safely in an individual context.

Assessment tasks

- Assignment 1
- Assignment 2
- Assignment 3
- Final examination

Learning and teaching activities

- see assessment tasks