

On-line course materials

MATH42061 - Representation Theory

Year: 4 - Semester: 1 - Credit Rating: 15

Aims

To introduce students to representations of groups over the field of complex numbers.

Brief Description

In the second and third year course units on group theory we have seen that abstract groups are quite complicated objects. One of the most fruitful approaches to studying these objects is to embed them into groups of matrices (to "represent" the elements of an abstract group by matrices). The advantage of this approach lies in the fact that matrices are concrete objects, and explicit calculations can easily be performed. Even more importantly, the powerful methods of linear algebra can be applied to matrices. The course is devoted to representations of finite groups by matrices with entries in the field of complex numbers.

Learning Outcomes

On successful completion of this course unit students will

- know the basic properties of complex representations of finite groups and be able to use them in examples;
- understand the relationship between a representation and its character;
- know the basic properties of characters and use them in examples;
- know the basic properties of a character table and be able to calculate character tables for certain small groups.

Syllabus

- Informal introduction to matrix representations, permutation representations and G -sets. [3 lectures]
- Definition and basic properties of complex representations of a finite group. Maschke's Theorem, Characters and character tables. [6]
- The special cases of: cyclic groups, abelian groups, 1-dimensional representations. [6]
- Schur's Lemma, orthogonality of characters, the number of irreducibles, the character degree divides the order of the group. [6]
- Induced representations, Frobenius Reciprocity, double coset formula, methods of calculation. Transitive and 2-transitive permutation representations and their characters. [6]

Teaching & Learning Process (Hours Allocated To)

Lectures	Tutorials/ Example Classes	Practical Work/ Laboratory	Private Study	Total
22	11	0	117	150

Assessment and Feedback

Mid-semester coursework: weighting 20%

End of semester examination: three hours weighting 80%

Further Reading

- B. Steinberg, *Representation Theory of Finite Groups*, Springer Verlag 2012
- J. P. Serre, *Linear Representations of Finite Groups*, GMT 42, Springer-Verlag
- G. James and M. Liebeck, *Representations and Characters of Groups*, CUP, 1993

Staff Involved

Prof Peter Symonds - Lecturer

Data source is EPS system

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