

TITLE: Representation theory of algebras

COURSE OUTLINE: This course is an introduction to the representation theory of finite dimensional associative algebras. To each such algebra corresponds a so-called quiver (oriented graph), and, conversely, to each quiver one can associate an algebra, the *path algebra of the quiver*. For example, the algebra of upper triangular 4x4 matrices with entries in some field k is the path algebra (over k) of the quiver

$$1 \rightarrow 2 \rightarrow 3 \rightarrow 4,$$

where the matrix entry at position (i, j) , with $1 \leq i \leq j \leq 4$, corresponds to the path $i \rightarrow (i + 1) \rightarrow \dots \rightarrow j$. Furthermore, one can visualize a module of the path algebra as a representation of its quiver, that is, a family of vector spaces (one for each vertex of the quiver) and a family of linear maps (one for each arrow of the quiver) between these vector spaces. Representation theory of algebras is the study of these modules and of the homomorphisms between them.

The theory has many applications in different branches of mathematics and physics including algebraic geometry, Lie theory, quantum groups and string theory.

Some of the topics covered in the course are: Algebras, modules, quivers, path algebras, representations of quivers, hereditary algebras, Euler characteristic, Auslander-Reiten theory.

PREREQUISITES: algebra and linear algebra.

GRADING SCHEME: weekly assignments.