<table>
<tr><td colspan="5">Academic subject:
Advanced Algebra</td></tr>
<tr><td colspan="2">Degree Class:
LM-40 - Matematica</td><td colspan="2">Degree Course:
Mathematics</td><td>Academic Year:
2018/2019</td></tr>
<tr><td colspan="2"></td><td colspan="2">Kind of class:
Optional</td><td>Year: | Period: 2</td></tr>
<tr><td></td><td></td><td colspan="2"></td><td>ECTS: 7
divided into
ECTS lessons:
6.5
ECTS exe/lab/tutor:
0.5</td></tr>
<tr><td colspan="5">Time management, hours, in–class study hours, out–of–class study hours
lesson: 52
exe/lab/tutor: 8
in–class study: 60
out–of–class study: 90</td></tr>
<tr><td>Language:
Italian</td><td>Compulsory Attendance:
no</td><td colspan="3"></td></tr>
<tr><td>Subject Teacher:
Roberto La Scala</td><td>Tel: +39 080 5442674
e–mail:
roberto.lascala@uniba.it</td><td>Office:
Department of Mathematics
Room 28, Floor 2</td><td colspan="2">Office days and hours:
Monday 11-13. Other days
and times by appointment.</td></tr>
<tr><td colspan="5">Prerequisites:
Mathematical knowledge which usually is acquired during the three years of a degree of L-35 class. Especially: algebraic structures and linear algebra.</td></tr>
<tr><td colspan="5">Educational objectives:
Acquiring concepts and methods of advanced algebra, especially the theory of modules and representations.</td></tr>
<tr><td>Expected learning outcomes (according to Dublin Descriptors)</td><td colspan="4">Knowledge and understanding:
Acquiring advanced concepts in modern algebra. Acquiring related mathematical proof techniques.

Applying knowledge and understanding:
The acquired theoretical knowledge is useful in great part of mathematics and its applications.

Making judgements:
Ability to analyze the consistency of the logical arguments used in a proof. Problem solving skills should be supported by the capacity in evaluating the consistency of the found solution with the theoretical knowledge.

Communication:
Students should acquire the mathematical language and formalism necessary to read and comprehend textbooks, to explain the acquired knowledge, and to describe, analyze and solve problems.

Lifelong learning skills:
Acquiring suitable learning methods, supported by textbooks consultation and by solving the exercises and questions periodically suggested during the course.</td></tr>
<tr><td colspan="5">Course program
Modules and representations. Free modules and their bases. Matrices with entries in rings. Non-zero and unit determinants. Modules over principal ideal domains. Submodules of a free module. Presentations of modules. Smith and Hermite normal form. Invariant and determinantal factors. Structure of finitely generated modules over a PID. Rank and torsion. Finitely generated abelian groups. The action of one endomorphism over a vector space. Similar matrices. Characteristic matrix. Characteristic and minimal polynomials. Companion matrices. Frobenius and Jordan canonical forms. Cayley-Hamilton theorem. Semisemplicity and nilpotency</td></tr>
</table>

of endomorphisms.
Linear representations of groups. Cyclic groups and discrete Fourier transform. Invariant inner products. Maschke theorem. Schur lemmas. Intertwining maps and algebras. Commutant algebra. The character of a representation. Inner product of characters. Character relations of type I and II. Structure of the group algebra. Characters of abelian groups. Restricted and induced representations. Frobenius reciprocity theorem.

Teaching methods:
Lectures and exercise sessions.

Auxiliary teaching:

Assessment methods:
Oral exam.

Bibliography:
Jacobson, Basic Algebra I, Dover Books on Mathematics
M. Artin, Algebra, Bollati Boringhieri, Torino, 1997
S. Lang, Algebra, Springer GTM, New York, 2002
B.E. Sagan, The symmetric group, Springer GTM, New York, 2000