Syllabus: MAS 6396

Department of Mathematical Sciences
Charles E. Schmidt College of Science
Florida Atlantic University

Spring, 2007. MAS 6396, Ideals, Varieties & Algorithms
3 credits.

Instructor
Rainer Steinwandt, Office SE 280
Phone: (561) 297-3353
Email: rsteinwa@fau.edu

Class Time and Place
Monday, Wednesday, Friday: 2:00 – 2:50 p.m., SE 215.

Office Hours
Monday, Wednesday, Friday: 11:00 a.m. – 1:00 p.m. or by appointment. Also, feel free to
just come to the office—whenever time permits, questions and discussions are welcome.
(If there should be any timing conflicts, like inevitable meetings during regular office
hours, this will be announced beforehand in class, whenever possible.)

Course Web Site
http://www.math.fau.edu/~srainer/MAS6396/MAS6396.html

Required Text and Materials
Most of the material will be taken from the book Ideals, Varieties & Algorithms (by
David Cox, John Little, Donal O'Shea, Springer). To prepare classes, the 2nd edition of
the book will be used, but any other edition will be fine, too, and you are not required to
buy the book.

Course Objectives
The course assumes familiarity with elementary concepts from algebra, as covered by the
qualifying exam in algebra, for instance. After completion of this course you should be
acquainted with basic techniques of computational algebraic geometry. You should
understand and be able to explain basic connections between ideals in polynomial rings and affine varieties. The course should enable you to apply Gröbner bases and Buchberger’s algorithm to solve basic computational tasks in connection with affine varieties and ideals in polynomial rings.

**Lecture Schedule**

Where possible, suggestions of course participants for topics of interest will be taken into account. The topics I intend to cover are listed below. The exact time frame per item varies (also in dependence of previous knowledge of the course participants), but a typical time frame is two weeks per item.

1. Introduction to polynomial rings and affine varieties
2. Gröbner bases and Buchberger’s algorithm
3. Introduction to elimination theory
4. Operations on ideals—computational aspects and geometric interpretation
5. Applications of Gröbner bases in elementary algebraic geometry

**Assessment Procedures**

There will be two homework projects $X_1$, $X_2$ and one exam $X_3$. Both homework projects and the exam will be assigned in class and collected on the date specified on the assignment. Homework projects can include a presentation to be given in class and/or require the use of a computer algebra system. (Programming experience is not assumed and, when necessary, access to a computer algebra system will be provided.) The scheduled assignment dates and maximum number of points for the items $X_1$, $X_2$ and $X_3$ are listed in the following table.

<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
<th>Max. points</th>
</tr>
</thead>
<tbody>
<tr>
<td>$X_1$</td>
<td>Feb 7, 2007</td>
<td>35</td>
</tr>
<tr>
<td>$X_2$</td>
<td>Mar 16, 2007</td>
<td>35</td>
</tr>
<tr>
<td>$X_3$</td>
<td>Apr 18, 2007</td>
<td>30</td>
</tr>
</tbody>
</table>

Homework projects or an exam returned after the specified deadline will not be accepted and graded with 0 points.

Both homework projects and the exam will be returned in class or can be picked up during office hours at the instructor’s office. At the end of the course, the final grades will be available at the instructor’s office (room SE 280). Please keep your exam and documentation of homework projects, so that a possible disagreement about your grade can be resolved.
Your overall grade in the course is derived from your cumulative performance as follows:

1. The points from the items $X_1$, $X_2$ and $X_3$ are added, yielding a final number of points $0 \leq P \leq 100$.
2. Your grade is derived from $P$ according to the following table.

<table>
<thead>
<tr>
<th>Value of $P$</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>$&gt; 94$</td>
<td>A</td>
</tr>
<tr>
<td>$&gt; 90 - 94$</td>
<td>A−</td>
</tr>
<tr>
<td>$&gt; 87 - 90$</td>
<td>B+</td>
</tr>
<tr>
<td>$&gt; 83 - 87$</td>
<td>B</td>
</tr>
<tr>
<td>$&gt; 80 - 83$</td>
<td>B−</td>
</tr>
<tr>
<td>$&gt; 75 - 80$</td>
<td>C+</td>
</tr>
<tr>
<td>$&gt; 65 - 75$</td>
<td>C</td>
</tr>
<tr>
<td>$&gt; 60 - 65$</td>
<td>C−</td>
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<tr>
<td>$&gt; 57 - 60$</td>
<td>D+</td>
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<td>$&gt; 53 - 57$</td>
<td>D</td>
</tr>
<tr>
<td>$\geq 50 - 53$</td>
<td>D−</td>
</tr>
<tr>
<td>$&lt;50$</td>
<td>F</td>
</tr>
</tbody>
</table>

**Make-up Tests and Extra Credit**

If you cannot attend the exam or hand in a homework project due to a relevant reason like significant health problems or being involved in a major traffic accident, you can make up the respective item. Extra credit work is not possible.

**Course Procedure**

The course is conducted in lecture/discussion style. Further on, presentations that are to be prepared as part of a homework project will be given in class. For assignments where access to a computer algebra system is necessary, computer and software access will be provided.

**Students with Disabilities**

In compliance with the Americans with Disabilities Act (A.D.A.) – Students who require special accommodations due to a disability to properly execute coursework must register with the Office for Students with Disabilities (OSD) located in Boca – SU 133 (561-297-3880), in Davie – MOD I (964-236-1222), or in Jupiter – SR 117 (561-799-8585) and follow all OSD procedures.
**Incomplete Grades**

A grade of I (incomplete) will only be given under certain conditions and in accordance with the academic policies and regulations put forward in FAU’s *Graduate Policies and Procedures Manual* (see http://www.fau.edu/academic/gradstud/pol.pdf). The student has to show exceptional circumstances why requirements cannot be met. A request for an incomplete grade has to be made in writing with supporting documentation, where appropriate.

**Classroom Etiquette and Academic Integrity**

Please refer to the guidelines for good practice in graduate education in FAU’s *Graduate Policies and Procedures Manual* (see http://www.fau.edu/academic/gradstud/pol.pdf).