Course Announcement - Summer 2010

Math 113: Introduction to Abstract Algebra

Instructor: Bernd Sturmfels

Office hours: Please catch me at the end of the class, or schedule an appointment by e-mail.
Contact: bernd at math, 925 Evans, phone messages: 642 6550

**Lectures: Monday and Wednesday 10:00-12:00am, 3 Evans Hall,
as well as Tuesday and Thursday, 10:00-11:00am, 3 Evans Hall
Discussion Sessions: Tuesday and Thursday, 11:00-12:00am, 3 Evans Hall.**

**First Day of Class: Monday, June 21.
First Midterm Exam: Thursday, July 8.
Second Midterm Exam: Thursday, July 29.
Last Day of Class and Final Exam: Thursday, August 12.**

Prerequisites: A solid background in lower-division mathematics.
Discrete Mathematics (Math 55) is essential. Acquaintance with Linear Algebra (Math 110) will help.

**Course text: A First Course in Abstract Algebra,
(Seventh edition) by John B. Fraleigh, Addison-Wesley, 2003.**

Syllabus: We will cover the first seven chapters of the text book:
1. Groups and Subgroups
2. Permutations, Cosets, and Direct Products
3. Homomorphism and Factor Groups
4. Rings and Fields
5. Ideals and Factor Rings
6. Extension Fields
7. Advanced Group Theory
My plan is to cover one section per lecture, according to the daily schedule listed below.
It is strongly recommended that you read the sections to be covered before coming to class.
One aim of this course is to prepare the students for Algebraic Geometry (Math 143).
Grobner Bases (# 28) are particularly important for reaching that goal.

Grading: There will be two midterms and one final exam. All three exams as well as the homework will count towards the final grade. The precise grading scheme is as follows: **Homework 15 %, Midterms 25 % each, Final 35 %**. The final exam score will override any lower midterm score. This means that, a posteriori, your final exam may count as 60 % or 85 % instead of 35 %. Active participation in the class will be noted and the instructor may award extra credit based on this information.

Exams: All three exams are closed book. You are asked to bring a blue book to write in. Please do not use any notes, text books, calculators, cell phones etc.
You must show all your work to get credit. Please write in complete sentences if time permits.

Homework: There will be a weekly homework assignment, to be handed in on Mondays at 10:00am, at the beginning of class. Late homework will not be accepted. No exceptions.

The daily homework assignments are posted below, next to the relevant date and text book section. We will grade two problems per homework set carefully and spot-check the others. The two graded problems are worth 1 point. They are marked with an asterisk. The spot-checked problems are worth 2 points So, the total score per homework set is 1+1+2 = 4 points.

DAILY SCHEDULE:

Week 1:

Monday, June 21, 10-11: **1. Introduction and Examples** [HW due 6/28: **9, 11, 14, 19, 39**]
Monday, June 21, 11-12: **2. Binary Operations** [HW due 6/28: **8, 18, 21, 24, 36, 37**]
Tuesday, June 22, 10-11: **3. Isomorphic Binary Structures** [HW due 6/28: **13, 16, 32, 33, 34**]
Wednesday, June 23, 10-11: **4. Groups** [HW due 6/28: **7, 9, 21, 29, 35***]
Wednesday, June 23, 11-12: **5. Subgroups** [HW due 6/28: **13, 26, 36, 40, 57**]
Thursday, June 24: 10-11: **6. Cyclic Groups** [HW due 6/28: **20, 23, 37, 48, 52***]

Week 2:

Monday, June 28, 10-11: **7. Generating Sets and Cayley Digraphs** [HW due 7/6: **7, 11, 16, 19**]
Monday, June 28, 11-12: **8. Groups of Permutations** [HW due 7/6: **9, 20, 44, 46**]
Tuesday, June 29, 10-11: **9. Orbits, Cycles and Alternating Groups** [HW due 7/6: **11, 18, 27, 35**]
Wednesday, June 30, 10-11: **10. Cosets and the Theorem of Lagrange** [HW due 7/6: **16, 28, 34, 40***]
Wednesday, June 30, 11-12: **11. Direct Products and Finitely Generated Abelian Groups** [HW due 7/6: **8, 17, 20, 26, 30**]
Thursday, July 1, 10-11: **13. Homomorphisms** [HW due 7/6: **19, 33, 41**]
Thursday, July 1, 11-12: **14. Factor Groups** [HW due 7/6: **14, 24, 33*, 34**]

Week 3:

Tuesday, July 6, 10-11: **15. Factor-Group Computations and Simple Groups** [HW due 7/12: **11, 15, 29, 37, 39**]
Wednesday, July 7, 10-11: **16. Group Actions on a Set** [HW due 7/12: **1, 2, 3, 10, 13**]
Wednesday, July 7, 11-12: **17. Applications of G-Sets to Counting** [HW due 7/12: **4, 5, 6, 9**]
Thursday, July 8: **FIRST MIDTERM. Here is the exam and the solutions.**

Week 4:

Monday, July 12, 10-11: **18. Rings and Fields** [HW due 7/19: **20, 26, 28, 44, 52**]
Monday, July 12, 11-12: **19. Integral Domains** [HW due 7/19: **4, 17, 18, 29**]
Tuesday, July 13, 10-11: **20. Fermat's and Euler's Theorems** [HW due 7/19: **5, 14, 24, 27**]
Wednesday, July 14, 10-11: **21. The Field of Quotients of an Integral Domain** [HW due 7/19: **2, 4, 9, 17**]
Wednesday, July 14, 11-12: **Elvia Gonzalez: Rubik's Cube**
Thursday, July 15, 10-11: **22. Rings of Polynomials** [HW due 7/19: **2, 9, 22, 24, 26**]

Week 5:

Monday, July 19, 10-12: **23. Factorization of Polynomials over a Field** [HW due 7/26: **4, 8, 10, 28, 34, 36**]
Tuesday, July 20, 10-11: **26. Homomorphisms and Factor Rings** [HW due 7/26: **3, 15, 20, 27**]
Wednesday, July 21, 10-11: **27. Prime Ideals and Maximal Ideals** [HW due 7/26: **8, 16, 18, 24, 34**]
Wednesday, July 21, 11-12: **Groebner Bases: The Joy of Solving Equations**
Thursday, July 22, 10-11: **28. Groebner Bases for Ideals** [HW due 7/26: **9, 19, 26, 32, 34**]

Week 6:

Monday, July 26, 10-11: **29. Introduction to Extension Fields** [HW due 8/2: **4, 16, 25, 31, 36**]
Monday, July 26, 11-12: **30. Vector Spaces** [HW due 8/2: **6, 10, 23, 27***]
Tuesday, July 27, 10-11: **31. Algebraic Extensions** [HW due 8/2: **12, 25, 26*, 27, 32, 36**]
Wednesday, July 28, 10-11: **33. Finite Fields** [HW due 8/2: **6, 10, 12, 13**]
Wednesday, July 28, 11-12 **Review for the Midterm**
Thursday, July 29: **SECOND MIDTERM. Here is the exam and the solutions.**

Week 7:
Monday, August 2, 10-12: **Review of Group Theory Basics** (Sections 1-17)
Tuesday, August 3, 10-11: **34. Isomorphism Theorems** [HW due 8/9: **2, 4, 6, 7, 9**]
Wednesday, August 4, 10-12: **35. Series of Groups** [HW due 8/9: **6, 12, 14, 18, 26**]
Thursday, August 5, 10-11: **36. Sylow Theorems** [HW due 8/9: **4, 6, 13, 14, 18, 22**]

Week 8:
Monday, August 9, 10-11: **37. Applications of the Sylow Theory**
Monday, August 9, 11-12: **39. Free Groups**
Tuesday, August 10, 10-11: **40. Group Presentations**
Tuesday, August 10, 11-12: **Exercises for Sections 37, 39 and 40**
Wednesday, August 11, 10-12: **Review for the Final Exam**
Thursday, August 12: **FINAL EXAM. Here is the exam and the solutions.**