

BRONX COMMUNITY COLLEGE
of the City University of New York

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

SYLLABUS: MATH 46 - Abstract Algebra (4 credits, 4 hrs. per week)

Prerequisite: MTH 42 or equivalent; and CUNY English Proficiency, or ENG 100 or 110, if required

TEXT: *A First Course in Abstract Algebra*, John B. Fraleigh, Addison-Wesley, 7th ed.

Section Number and Topic	Page	Exercises*
0. Sets and Relations	8	13, 16, 17, 29, 32, 36 / 19#
1. Introduction and Examples	19	12-14, 16, 18, 20, 38 /
2. Binary Operations	25	2, 4, 5, 7-11/ 17, 19, 22, 34
3. Isomorphic Binary Structures	34	1, 2, 4, 7, 10/ 11, 15, 17, 23, 26-28, 33#
4. Groups	45	1-5, 8-10, 11-14/ 20, 25 a,b,c,g,h, 29, 34
5. Subgroups	55	1-7, 9, 11, 12, 20, 23, 26, 29, 31/ 36, 39, 43, 51
6. Cyclic Groups	66	1, 3, 6, 8-11, 12-16, 18-22, 24, 26/ 28, 32, 38, 39, 44, 47, 55
8. Groups of Permutations	83	1-5, 7, 11-13, 17, 18, 27/ 35, 40-43, 48, 49
9. Orbits, Cycles, Alternating Groups	94	3, 5, 7, 8, 10, 14, 15/ 23, 27, 29
10. Cosets, the Theorem of Lagrange	101	1, 2, 4-8, 12, 13, 15/ 19, 28-31, 34, 45, 46#
11. Abelian Groups	110	1, 2, 6, 8, 11, 12, 14, 16, 18, 21, 26/ 27, 29, 32, 34, 36, 47, 48
13. Homomorphisms	133	1, 2, 4, 6, 7, 9, 12, 13, 15, 17, 19, 20, 25, 27, 29/ 32, 37, 39, 41, 44, 45, 47, 48, 50
14. Factor Groups	142	1, 3, 4, 5, 7, 9, 12, 13, 15, 16/ 23, 24, 27, 28, 30-33, 37, 38
15. Factor-Group Computations	151	1-3, 8, 9, 13, 14, 16, 19, 20, 25, 26/ 30, 31, 34, 39#, 40
18. Rings and Fields	174	1-8, 11, 13, 14, 16, 17, 19, 24, 28/ 31, 33, 35, 37, 38, 41, 44, 52
19. Integral Domains	182	1-4, 6, 8, 11, 14/ 17, 26, 28, 29
20. Fermat's and Euler's Theorems	189	1-5, 7-9, 11, 12, 15/ 20, 23, 27, 28#
21. Fields of Quotients	197	7, 8, 10, 11/
22. Rings of Polynomials	207	1-3, 6, 7, 9, 11, 14, 16, 17/ 20, 21, 23, 25, 27
23. Factoring Polynomials over Fields	218	1-5, 9, 10, 12, 14, 16, 18, 21/ 26-28, 34

* Exercises listed before the slash (/) are required; others are recommended. # denotes a challenge.

In abstract algebra we study sets of objects which behave more or less like numbers do. That is, they combine under operations similar to addition and multiplication, and obey certain familiar rules such as associative and distributive laws. A *field*, for example, is a set of objects that behave like the rational numbers; a *ring* behaves like the subset of integers. These objects are abstractions in the sense that operations denoted $+$ and \cdot may have nothing to do with ordinary addition and multiplication.

Rings and fields are built out of simpler objects called *groups*. About 2/3 of this course is devoted to the study of groups (sections 0-15). Once fields and rings are defined (sections 18-19), their abstract properties can be used to prove subtle results about ordinary numbers, such as Fermat's and Euler's theorems (sections 20-21). The study of polynomial rings (sections 22-23) is the beginning of a very deep theory about the solvability of algebraic equations, called Galois theory. At the end of this course, you will have most of the tools necessary to understand this theory.

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