UNIVERSITY OF CALGARY

FACULTY OF SCIENCE
Department of Mathematics and Statistics

Pure Mathematics 315 / 317	Algebra I / Honours Algebra I

(see Course Descriptions under the year applicable: http://www.ucalgary.ca/pubs/calendar/)

Syllabus

Topics	**Number of hours**
Sets and Functions; induction; proof by contradiction and contrapositive	3
Number systems: integer, rational, real complex; definitions of rings and fields	3
Divisibility, greatest common divisor and Euclidean algorithm; fundamental theorem of arithmetic	3
Equivalence relations and the integers modulo n; congruences and equations in Z/nZ	3
Solving equations in Z/nZ; the Chinese remainder theorem; Z/nZ is a field if and only if p is prime	3
The ring of polynomials over a field; greatest common divisor and the Euclidean algorithm; irreducible polynomials	3
Unique factorization; recall of ring axioms; ideals; Z and F[x] are principal ideal rings	3
Homomorphisms and kernels; quotients, first isomorphism theorem; F[x]/f(x) is a field iff f is irreducible	3
Adjoining the root of an irreducible polynomial; construction of finite fields	3
Group axioms; cyclic and dihedral groups; matrix groups; permutations and the symmetric group	3
Subgroups; cosets and Lagrange's theorem; normal subgroups	3
Homormorphisms and kernels; quotient groups; examples	3
Group actions and Cayley's theorem; orbit counting formula; combinatorial applications (time permitting)	
TOTAL HOURS	**36**

Pure Math 317- Honours Algebra I

1 Overview
This course aims to give a formal and abstract foundation for the three fundamental objects in modern algebra: groups, rings and fields. Designed for honours students, this course assumes that students have a richer background in general proof techniques and mathematical logic than students in its peer course, Pure Math 315.

2 Subject specific knowledge

By the end of this course, students are expected to:

1. state the axioms of a group and deduce conclusions from these axioms.

2. identify and prove basic properties of examples of groups.

3. describe the structure of a cyclic group.

4. state, prove and apply the isomorphism theorem for groups.

5. state, prove and apply Lagrange's theorem for groups.

6. determine the index of a subgroup.

7. state the axioms of rings and fields and deduce conclusions from these axioms.

8. define ideals and principle ideals of rings, and give examples of both.

9. state and apply irreducibility criteria for rings of polynomials.

10. state, prove and apply the isomorphism theorem for rings.

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