

## MATH 555 COMMUTATIVE ALGEBRA

### 1. DESCRIPTION

Basics of rings and ideals. Rings of fractions, integral dependence, valuation rings, discrete valuation rings, Dedekind domains, fractional ideals. Topologies and completions, filtrations, graded rings and modules. Dimension theory.

### 2. TEXTBOOK

M. F. Atiyah & I. G. Macdonald, INTRODUCTION TO COMMUTATIVE ALGEBRA, Addison-Wesley, 1969. Paperback edition, Perseus Publishing, December 1994.

### 3. SYLLABUS

WEEK	MATERIAL
1	<b>RINGS &amp; IDEALS.</b> Prime and maximal ideals. Nilradical and Jacobson radical. Operations on ideals.
2	Extension and contraction.
3	<b>MODULES.</b> Nakayama's Lemma. Exact sequences.
4	Tensor products of modules. Exactness.
5	<b>RINGS AND MODULES OF FRACTIONS.</b> Local properties. Extension & contraction in rings of fractions
6	<b>INTEGRAL DEPENDENCE AND VALUATIONS.</b> Integral dependence. Going-up and going-down theorems.
7	Valuation rings. Hilbert's Nullstellensatz.
8	<b>CHAIN CONDITIONS.</b>
9	<b>NOETHERIAN RINGS.</b>
10	<b>ARTINIAN RINGS.</b>
11	<b>DISCRETE VALUATION RINGS.</b>
12	<b>DEDEKIND DOMAINS.</b>
13-14	<b>TOPOLOGIES &amp; COMPLETIONS.</b>
14-15	<b>DIMENSION THEORY.</b>

### 4. GRADING POLICY

Take-home Exam 1	100
Take-home Exam 2	100
Presentations	100