

## **MATH 553 Introduction to Homological Algebra (Term 101)**

Review of free, projective, and injective modules, direct limits. Watt's theorems. Flat modules. Localization. Noetherian, semisimple, Von Neumann regular, hereditary, and semi-hereditary rings. Homology, homology functors, derived functors. Ext. and Tor. homological dimensions, Hilbert syzygy theorem.

### **TEXTBOOK**

M. S. Osborne, Basic Homological Algebra, GTM, Springer, New York, 2000.

J. J. Rotman, An Introduction to Homological Algebra, Academic Press, Boston, 1979.

### **RESEARCH PAPER**

François Couchot, Finitistic Weak Dimension of Commutative Arithmetical Rings, AJSE D-Math, to appear.

### **SYLLABUS**

<b>WEEK</b>	<b>MATERIAL</b>
1	Categories and Functors. Tensor products Sums and products
2	Exactness. Adjoint Direct limits. Inverse limits
3	Free modules. Projective modules Injective modules
4	Watt's theorems Flat modules. Localization
5	Noetherian rings Semisimple rings
6	Von Neumann regular rings Hereditary and Dedekind rings
7	Semihomomorphisms and Prüfer rings Quasi-Frobenius rings
8	Homology functors Derived functors
9	Elementary properties of Ext Ext and extensions
10	Elementary properties of Tor Tor and torsion
11	Homological dimensions
12	Hilbert's Syzygy theorem
13	Finitistic weak dimension of commutative arithmetical rings (1)
14	Finitistic weak dimension of commutative arithmetical rings (2)
15	Finitistic weak dimension of commutative arithmetical rings (3)

## **4. GRADING POLICY**

Presentations	100
Research project	100
Take-home Exam (20 problems)	200