E0 231 ALGORITHMIC ALGEBRA
DEPT. OF COMPUTER SCIENCE AND AUTOMATION

INSTRUCTOR: AMBEDKAR DUKKIPATI

DESCRIPTION OF THE COURSE

This is a course about study of polynomials in several variables and equations involving them. Study of polynomials is integral part of many disciplines of mathematics and theoretical computer science. This course centers around the theory of *Gröbner bases* and its applications.

Gröbner bases were introduced by Buchberger (1965) as a computational tool for testing solvability of polynomial equations. It serves as a general algorithmic solution of some fundamental problems in commutative algebra and algebraic geometry. Since then the theory of Gröbner bases has held an important place in mathematical research. Due to its algorithmic roots and its applications in coding, cryptography optimization, statistics etc., it has further attracted attention from various disciplines: computer science, operations research, electrical engineering and applied mathematics.

This course emphasizes rigorous reasoning and analysis, and the skills to work with abstract concepts. The course is self-contained and some exposure to discrete mathematics would be helpful.

OUTLINE OF THE COURSE

This course is taught in four parts

Basic algebraic notions: Integers, Euclidean algorithm, division algorithm, rings and polynomial rings, abstract orders and Dickson's lemma.

Introduction to Gröbner bases: Term orders, multivariate division algorithm, Hilbert basis theorem, Gröbner bases and Buchberger algorithm, computation of syzygies, basic algorithms in ideal theory, universal Gröbner bases.

Algebraic applications: Hilbert nullstellensatz, implicitization, decomposition, radical and zeros of ideals

Other applications: Toric ideals and integer programming, applications to graph theory, coding, cryptography, statistics.

REFERENCES

Ideals, Varieties and Algorithms by D. Cox and O'Shea, Springer; 2nd ed. 1997.

Algorithmic Algebra by Bhubaneswar Mishra, Springer, 1993.

Organizational meeting:
Wednesday 06 January 2011
Venue: L6 (Lecture Hall Complex)
Time: 11:30 - 1:00 pm