King Fahd University of Petroleum and Minerals,
Department of Mathematics
MATH-655 Syllabus, T-221,
Instructor: Dr. Muhammad Imran Qureshi
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Course code and Name: MATH-655, Applied and Computational Algebra

Credit Hours: 3–0–3 (Three lecture hours per week)

Textbook: *Cox, Little and O'Shea*: Ideals, Varieties and Algorithms: An Introduction to Computational Algebraic Geometry and Commutative Algebra. ISBN 978-1-4419-2257-1 (3rd edition).

Reference book: *Cox, Little and O'Shea*: Using Algebraic Geometry, Graduate Texts in Mathematics, Springer, ISBN 978-0-387-27105-7 (2nd edition).

Course description: This course introduces students to some fundamental ideas in computational commutative algebra, and their applications. The course will cover the review of rings and fields, polynomial rings, affine spaces, division algorithms in polynomial rings, Hilbert basis theorem and Gröebner basis, Büchberger's algorithm, elimination and extension theorems, geometry of elimination, Zariski topology, Hilbert's Nullstellensatz, ideal–variety correspondence, Radical algorithm, primary decomposition and applications of these ideas.

Course learning outcomes At the end of the course the students will:

- become familiar with the ideals in polynomial rings and perform various computations with them using algorithmic methods.
- learn about the Gröebner basis and use them for understanding of geometric properties of ideals in polynomial rings
- understand Büchberger algorithm and its role in computing the Gröebner basis
- become familiar with elimination, extension theorems and their application to geometry
- learn the correspondence between algebra and geometry by using Hilbert's Nulletellensatz.

Prerequisite Graduate Standing, consent of the instructor

Grading policy The final grade will be based on the following distribution.

- Assignments and Tests: 30 %
- Project Presentation: 10%
- Mid term Examination: 25%
- Final Examination: 35%

Office Hours TBA

Attendance Policy All the standard KFUPM attendance policies must be followed by the students in this course.