**University of Management and Technology**

**School of Science**

***Department of Mathematics***

**Course Code:** **MTH 603/723**

**Course Title: Computational Algebra and its Applications**

**Program: MS MA/PhD MA**

**Course Outline**

**(Spring 2021)**

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| **Schedule**  |  | **Pre-requisite** |  |
| **Course Coordinator** |  Dr. Zohaib Zahid | **Contact** | Ext 3493Cell:  |
| **Course****Description** | This course is designed to equip students with the combinatorial perspective of commutative algebra and vice versa. Some algebra related computer softwares will be applied. The main objective of this course is to prepare students for research in different areas of Combinatorial Commutative Algebra.**Major Contents:**Rings, Subring, Ideals, Finitely generated ideals. Polynomial Rings, Polynomials in Several Variables, Monomial Ideals, Operations with ideals: Intersection of Ideals, Colon Ideals, Prime Ideals, Primary Ideals, Primary Decomposition, Krull Dimension, Monomial Orderings, The Division algorithm in , Initial Ideal, Hilbert’s Basis Theorem, Grӧbner Basis, Properties of Grӧbner Basis, Buchberg’s Algorithm, Reduced Grӧbner Basis, Application of Grӧbner Basis, Simplicial Complexes: vectors, vectors, Stanley-Reisner Ideals, Facet Ideals, Alexander Dual, Hilbert Function of SC.  |
| **Expected****Outcomes** | Students will be able to understand and compute:* Operations with Ideal: Colon Ideals, Intersection of Ideals
* Division Algorithm
* Hilbert Series of Monomial Ideals
* f-vectors, h-vectors, SR-Ideals, Facet Ideals, Alaxander Dual, Hilbert Function of Simplicial complexes,
* Finding Grӧbner/Reduced Grӧbner Basis using Buchberg’s Algorithm
* Solving Polynomial Equations in Several Variables.
* Use Singula/CoCoA softwares for all the above computations
* Present atleast one advanced topic from the above contents.
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| **Text** **Book(s)** | 1. Monomial Ideals, Jurgen Herzog, Takayuki Hibi, Springer, 2011.
2. Introduction to Commutative Algebra, M.F. Atiyah, I.G. Macdonald, Addison-Wesley.
 |
| **Reference books** | 1. Monomial Algebras, Rafael H. Villarreal, Marcel Dekker, Springer, 2001.
2. An Introduction to Grobner Bases, Viviana Ene, Jurgen Herzog,
3. Combinatorial Commutative Algebra, Ezra Miller, Bernd Sturmfels, 2005.
4. A SINGULAR Introduction to Commutative Algebra, Gert-Martin Greuel, Gerhard Pfister, Springer-Verlag, 2nd Edition, 2007.
5. Abstract Algebra, Dummit Foote, 3rd ed. John Wiley & Sons, 2004.
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| **Assignments** | 2 Assignments | **Project** | 1 project from advanced topics |
| **Mid Term****Examination** | 1 Midterm Exam  | **Final** **Examination** | 1 Final Examination |
| **Attendance** **Policy** | SA would be reported if 5 two and half classes are missed without any accidental or medical or any extreme family matters. |
|  | **Grading Policy** |
| **Assignments**  |  15% | **Project** | 20% |
| **Mid Term****Examination** | 25% | **Final** **Examination** | 40% |