



# COMPUTATIONAL COMMUTATIVE ALGEBRA

**PROF. MANOJ KUMMINI**

Department of Mathematics  
Chennai Mathematical Institute

**TYPE OF COURSE** : New | Elective | UG/PG

**COURSE DURATION** : 12 weeks (20 Jul' 20 - 9 Oct' 20)

**EXAM DATE** : 17 Oct 2020

**PRE-REQUISITES** : Introduction to basic theory of rings, modules

**INTENDED AUDIENCE** : Advanced undergraduate / post-graduate students

**COURSE OUTLINE :**

This is an introductory course in computational commutative algebra. Topics in a typical first course in commutative algebra are developed along with computations in Macaulay2. The emphasis will be on concrete computations, more than on giving complete proofs of theorems.

**ABOUT INSTRUCTOR :**

Prof. Manoj Kummini is currently Professor at the Department of Mathematics, CMI. His research interest primarily lies in commutative algebra. He did his PhD from University of Kansas, Lawrence, KS, USA

**COURSE PLAN :**

**Week 1:** Introduction: rings and ideals, ring homomorphisms, Hilbert basis theorem, Hilbert Nullstellensatz, introduction to Macaulay2

**Week 2:** Groebner bases, ideal membership, solving systems of polynomial rings

**Week 3:** Modules.

**Week 4:** Associated primes and primary decomposition

**Week 5:** Associated primes and primary decomposition, ctd.

**Week 6:** Integral extensions, integral closure, Noether normalization

**Week 7:** Integral extensions, integral closure, Noether normalization, ctd.

**Week 8:** Hilbert functions, dimension theory

**Week 9:** Hilbert functions, dimension theory ctd.

**Week 10:** Applications to geometry.

**Week 11:** Homological algebra: depth, Koszul complex

**Week 12:** Homological algebra: free resolutions, Auslander-Buchsbaum formula