



**SECOND SEMESTER 2019-2020**

Course Handout Part II

Date:06-01-2020

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

Course No. : MATH F481  
Course Title : COMMUTATIVE ALGEBRA  
Instructor-in-Charge : PRATYUSHA CHATTOPADHYAY

**Scope and Objective of the Course:**

This course introduces commutative algebra, which is the foundation for several advanced topics in Mathematics like computational commutative algebra, advanced commutative algebra, algebraic geometry, algebraic number theory and classical algebraic K-theory.

Commutative algebra is the study of commutative rings. In this course, we will learn several fundamental topics like finitely generated modules, tensor product of modules, rings and modules of fractions, localization, primary decomposition, integral dependence and valuations, Artinian rings, Noetherian rings, discrete valuation rings, Dedekind domains, and dimension theory.

**Textbooks:**

1. M. F. Atiyah and I. G. Macdonald, *Introduction to commutative algebra*, Taylor & Francis, 1994.

**Reference books**

1. David S. Dummit and Richard M. Foote, *Abstract algebra*, 3<sup>rd</sup> Edition, Wiley India 2004.
2. N S Gopala Krishnan, *Commutative algebra*, 2<sup>nd</sup> Edition - India Universities Press 2016.

**Course Plan:**

Lecture No.	Learning objectives	Topics to be covered	Chapter in the Text Book
1-4	To learn about rings, ideals, quotient rings, ring-homomorphisms, zero-divisors, nilpotent element, nilradicals, Jacobson radicals, and operations on ideals.	Basics of rings and ideals	1
5-9	To learn about modules, module-homomorphisms, submodules, quotient modules, operations on submodules, finitely generated modules, and exact sequences.	Basics of modules	2
10-13	To learn how to construct rings and modules of fractions, local properties, extended and contracted ideals in rings of fractions.	Rings and modules of fractions	3
14-17	To learn about primary ideals, decomposition of an ideal into primary ideals, 1 <sup>st</sup> and 2 <sup>nd</sup> uniqueness theorem.	Primary decomposition	4



18-23	To learn about integral dependence, integrally closed integral domains, going-up theorem, going-down theorem, and valuation ring	Integral dependence and valuation	5
24-27	To learn about ascending and descending chain conditions, basics of Noetherian and Artinian rings and composition series.	Chain conditions	6
28-31	To learn about various properties of Noetherian rings, primary decomposition of an ideal of a Noetherian ring, and Hilbert's basis theorem.	Noetherian rings	7
32-35	To learn about various properties of Artinian rings, its relation with Noetherian rings and structure theorem for Artinian rings.	Artin rings	8
36-39	To learn about discrete valuation map, construction of discrete valuation rings, Dedekind domains and various properties of these rings.	Discrete valuation rings and Dedekind domains	9
40-42	To learn about various notions of dimensions and relation between them.	Dimension theory	11

### Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Quiz (4)	To be announced	30	To be announced	Closed book
Mid-Semester exam	1.5 hours	30	6/3 1.30 -3.00 PM	Open book
Comprehensive exam	3 hours	40	13/05 FN	Closed book

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** The notices concerning this course will be announced on the CMS Notice Board only.

**Make-up Policy:** Make-up tests will be conducted only for genuine cases and prior permission has to be obtained from the I/C.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**  
**MATH F481**

