Birla Institute of Technology & Science, Pilani
Hyderabad Campus

SECOND SEMESTER 2022-2023

Course Handout Part II

Date: 16-01-2023

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, and Dedekind domains.

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*, 3rd Edition, Wiley India 2004.
2. N S Gopala Krishnan, *Commutative algebra*, 2nd 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, tensor product of 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, 1st and 2nd 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. Definitions and results required from Field Theory and Bilinear Forms will be recalled.	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
36-40	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

Evaluation Scheme:

Component	Duration	Weightage (%)	Date & Time	Nature of Component
Assignment	To be announced	15	To be announced	Open book
Quiz	To be announced	20	To be announced	Open book
Mid-Semester exam	1.5 hours	25	18/03 9.30 - 11.00AM	Closed book
Comprehensive exam	3 hours	40	19/05 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.

INSTRUCTOR-IN-CHARGE
MATH F481