BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani-K K Birla Goa Campus

FIRST/SECOND SEMESTER

Course Handout (Part II)

Date:…….

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

Course No. : **MATH G513**
Course Title : Topics in Algebra
Instructor-in-charge :
Instructors :

1. **Course Description:** In this course, students will learn Rings and Ideals, Fields, Field extension, Algebraic extension, Galois extension, Finite fields and applications, Introduction to Modules, Free modules, Finitely generated modules, Nakayama's lemma, Tensor product of modules, Direct limits, Alternating product, Flat modules, Absolutely flat rings, Projective modules, Finitely presented modules, Noetherian rings and modules, Hilbert basis theorem, Artinian Rings, Structure theorem for finitely generated modules over Principal Integral Domain (PID), Localisation of Rings and Modules.

2. **Scope and Objective of the Course:** This course is essentially meant for Ph.D. scholars before they embark on research in a specific area and also to motivated undergraduate students of mathematics who have thorough knowledge in the subject of Algebra. The purpose of this course is to introduce some advanced topics in algebra as well as familiarize with tools essential in many other areas of mathematics. Some of the details are expected to be filled by students as home-assignments or by presenting as seminars.

3. **Text Books:**
   (1) Artin, Michael.; Algebra. Pearson Education, 2011.
   (2) Atiyah, M. F.; Macdonald, I. G. Introduction to commutative algebra. CRC Press, 2018.
   (3) Dummit, David S.; Foote, Richard M. Abstract algebra. Third edition. John Wiley and Sons. 2003.

4. **Reference Books:**

(1) Artin, Emil.; Galois Theory. Dover Publications, 1988.
(2) Cox, David A.; Galois Theory, Wiley Interscience, 2011.
(3) Matsumura, H.; Commutative Ring Theory, Second edition, Cambridge University Press., 1989.

5. **Lecture Plan:**

Lecture numbers	Module	Topics to be covered
Lectures: 1-6 (TB-2: Ch-1)	1. Review of Rings and Ideals	Rings and homomorphisms, Ideals, Quotient rings, Zero-divisors, Nilpotent elements, Units, Prime ideals and maximal ideals, Local ring, Nilradical and Jacobson radical, Operations on ideals, Extension and contraction, Prime spectrum of a ring and Zariski topology.
Lectures: 7-18	2. Fields	Characteristic of a field, Prime subfield, Field extension, degree of an extension, Algebraic extension, Splitting Field, Normal

(TB-1: Ch-15, 16)		and Separable extension, Galois groups, Galois extension, Finite fields, Construction of finite fields and it's applications.
Lectures: 19-33 (TB-2: Ch-2)	3. Modules	Modules and Module homomorphisms, Submodules and Quotient modules, Operations on submodules, Examples, Free modules, Finitely generated modules, Nakayama's lemma. Tensor product of modules, Restriction and extension of scalars, Exactness properties of the tensor product, Direct limits, Tensor products and direct limits. Alternating product, Flat modules, Absolutely flat rings, Projective modules, Finitely presented modules, Noetherian rings and modules, Hilbert basis theorem, Artinian Rings.
Lectures: 34-36 (TB-3: Ch-12)	4. Modules over PID	Structure theorem for finitely generated modules over principal ideal domains (PID) (Existence and uniqueness) and its applications.
Lectures: 37-41 (TB-2: Ch-3)	5. Localisation of Rings and Modules	Rings and Modules of fractions, Local properties, Extended and contracted ideals in rings of fractions.

6. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage (%)	Date, Time	Remarks
1	Mid sem	90 Min.	30	***	***
2	Tutorial Test/Quiz/ Assignments/Seminars	***	30	***	***
3	Comprehensive Exam	3 Hours	40	***	***

***** To be announced later.**

7. Problems: Students are strongly advised to work out the problems in the textbook and do similar problems from the reference books.

8. Chamber Consultation Hour:

9. Notices:

10. Make-up Policy:

Instructor-In-Charge
MATH G513