Course No	Course Name	L-T-P-Credits
MA 404	**Abstract Algebra**	**3-1-0: 4**

Prerequisite: nil

Course Objectives: This course aims to provide fundamental concept of abstract algebra, which is one of the basic pillars of modern mathematics. Abstract algebra gives to student a good mathematical maturity and enables to build mathematical thinking and skill.

Course Outcomes: After successful completion of the course, students will be able to:

1. Demonstrate the understanding of binary operations and algebraic structure forming a group and should be fluent with basic and standard properties of groups, subgroups and homomorphisms.
2. Demonstrate the understanding of cyclic supgroups, abelian subgroups, group actions and class equation, Syllow subgroups, direct product of groups and solve relevant problems.
3. Demonstrate the understanding of algebraic structure forming a ring and should be fluent with basic and standard properties of rings, ring homomorphisms and ideals in rings.
4. Demonstrate the understanding of various types of rings like integral domains, division rings, fields, Euclidean domain, principal ideal domain, unique factorization domains, polynomial rings, and able to understand the concept of irreducible and prime element in a ring.
5. Demonstrate the understanding of introductory concept of field extensions

SYLLABUS

Module	Contents	Hours
I	Groups: binary operation and its properties, definition of a group, examples and basic properties. Subgroups, cosets and Lagrange's theorem. Cyclic groups and generators, order of a group. Normal subgroups, quotient group. Homomorphisms, kernel and image of a homomorphism, isomorphisms and automorphisms.	10
II	Group Actions and Applications:permutation groups, Cayley's theorem, direct product of groups, group action on a set, semi-direct product, Sylow's theorems, structure of finite abelian groups, applications, some nontrivial examples.	08
III	Rings: definition and basic concepts in rings, examples and basic properties, zero divisors, integral domains, fields, characteristic of a ring, quotient field of an integral domain, subrings, ideals, maximal ideal, prime ideal, definition and examples, quotient rings, isomorphism theorems.	09

IV	Fields: ring of polynomials, prime, irreducible elements and their properties. Eisensteins irreducibility criterion and Gauss's lemma. UFD, PID and Euclidean domains. Ring of polynomials over a field, field extensions, algebraic and transcendental elements, algebraic extensions, splitting field of a polynomial, algebraic closure of a field.	09

Essential Readings:

1. I. N. Herstein, "*Topics in Algebra*", Wiley, 2nd edition, 2006.
2. D. S. Dummit and R. M. Foote, "*Abstract Algebra*", Wiley, 3rd edition, 2011.

Supplementary Readings:

3. J. B. Fraleigh, "*A First Course in Abstract Algebra*", Pearson Education India, 7th edition, 2013.
4. J. A. Gallian, "*Contemporary Abstract Algebra*", Cengage, 8th edition, 2013.
5. N. Jacobson, "*Basic Algebra I*", Dover Publications Inc, 2nd edition, 2009.