STEPHEN F. AUSTIN STATE UNIVERSITY

Department of Mathematics and Statistics

Math 412–Introduction to Algebraic Systems
Course Syllabus

Course description: Introduction to the study of algebraic systems with particular emphasis on concrete examples of the basic algebraic structures, groups, rings, integral domains, and fields.

Credit hours: 3

Course Prerequisites and Corequisites: MTH 311

Course outline: Approximate time spent

- **Sets & Binary Operations** 15%
  - Basic set theory
  - Equivalence relations
  - Binary operations
  - Binary structures
  - Isomorphic structures
  - Commutativity
- **Introductory Group Theory** 30%
  - Definitions of group and subgroups
    - Canonical examples
    - Subgroup tests
    - Abelian groups
  - Notions of homomorphism and isomorphism
    - Basic definitions
    - Properties
    - Tests for proving homomorphism
    - Tests for proving isomorphism
  - Cyclic groups
    - Fundamental Theorem of Cyclic Groups
  - Generating Sets and Cayley diagrams
- **Permutations, Cosets and Direct Products** 25%
  - Permutation groups
  - Orbits and cycles
  - Alternating groups
  - Cosets
    - Theorem of Lagrange
  - Direct products
  - Finitely generated abelian groups
- **Homomorphisms** 15%
  - Definition and intuition of homomorphism
  - Basic properties
  - Tests for proving homomorphism
  - Tests for proving isomorphism
  - Normality and factor groups
- **Rings and Fields** 15%
  - Definition and basic examples of ring
  - Definition and basic examples of integral domain
  - Definition and basic examples of field

MATH 412 – Algebraic Systems
Syllabus Continuation

Student Learning Outcomes (SLO): At the end of MTH 312, a student who has studied and learned the material hsould be able to:

1. Recognize and prove theorems about equivalence relations, group structures, and basic ring structures. [PLO: 2,3]
2. Recognize cyclic groups and apply the fundamental theorem of cyclic groups. [PLO: 3]
3. Recognize subgroups and prove that a given subset of a group is a subgroup. [PLO: 2,3]
4. Construct and manipulate group and ring homomorphisms. [PLO: 2,4]
5. Read and construct Cayley diagrams. [PLO: 2]
6. Connect the definitions to their common applications in lower level mathematics. [PLO: 1,4]
7. Recognize and interpret theorems to prove properties about specific algebraic structure. [PLO: 1,3,4]
8. Use the skills of proof by contradiction, proof by contraposition, and proof of set equality. [PLO: 3]
9. Test a potential isomorphism for being well-defined, a homomorphism, one-to-one and onto. [PLO: 1,2]
10. Understand mappings and use definitions of one-to-one, onto, well-defined, homomorphism, isomorphism and others to characterize a given map. [PLO: 1,4]
11. Create factor groups and interpret elements of factor groups accurately. [PLO: 2,4]
12. Recognize and construct classic examples of rings, integral domains and fields. [PLO: 2,3]
13. Interpret permutations and symmetries in a group theoretic context. [PLO: 1,2,4]

Program Learning Outcomes (PLO):

Students graduating from SFASU with a B.S. degree and a major in mathematics will:

1. Demonstrate comprehension of core mathematical concepts. [***Concepts***]
   (notion of theorem, mathematical proof, logical argument)
2. Execute mathematical procedures accurately, appropriately, and efficiently. [***Skills***]
   (calculus, algebra, routine, nonroutine, applied)
3. Apply principles of logic to develop and analyze conjectures and proofs. [L***ogical Reasoning***]
   (quantifiers, breaking down mathematical statements, counterexamples)
4. Demonstrate competence in using various mathematical tools, including technology, to formulate, represent, and solve problems. [***Problem Solving***]
   (calculus tools, algebra tools, applied tools, nonstandard problem solving)

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