**King Fahd University of Petroleum & Minerals**

Department of Mathematics and Statistics

Abstract Algebra (Math551); Semester 122

**Dr. Jawad Abuhlail**

**Textbook:** P. Grillet, *Abstract Algebra*, 2nd edition, Graduate Texts in Mathematics 242, Springer (2007).

**Further Reading:**

- S. Lang, *Algebra*, Revised third edition. Graduate Texts in Mathematics 211, *Springer* (2002)
- R. Wisbauer, *Foundations of module and ring theory. A handbook for study and research*, Algebra, Logic and Applications 3, Gordon and Breach Science Publishers (1991).

| **MATH 551 Abstract Algebra (3-0-3)** |
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| Basic definitions of rings and modules, homomorphisms, sums and products, exactness, Hom and tensor, adjoint isomorphism, free, projective and injective modules. Chain conditions, primary decomposition, Noetherian rings and modules, Artinian rings, structure theorem. |
| Prerequisite: MATH 345. (MATH 450 is recommended) |

**Syllabus**

| Topic(s) | Section(s) | Week |
|---|---|---|
| Rings; Subrings and Ideals; Homomorphisms | III.1; III.2; III.3 | 1 |
| Polynomial Rings in One/Several Variables; Noetherian rings | III.5; III.6; III.11 | 2 |
| Primary Decomposition | VI.1 | 3 |
| Modules; Homomorphisms; Direct Sums and Products | VIII.1; VIII.2; VIII.3 | 4 |
| Free Modules; Vector Spaces | VIII.4; VIII.5 | 5 |
| Modules over Principal Ideal Domains | VIII.6 | 6 |
| Chain Conditions | VIII.8 | 7 |
| **Mid Term Exam** | | |
| Simple Rings and Modules; Semisimple Modules | IX.1; IX.2 | 8 |
| The Artin-Wedderburn Theorem; Primitive rings | IX.3; IX.4 | 9 |
| The Jacobson Radical; Artinian Rings | IX.5; IX.6 | 10 |
| Exact Sequences; Pullbacks and Pushouts | X.1; X.2 | 11 |
| Projective Modules; Injective Modules; The Injective Hull | X.3; X.4; X.5 | 12 |
| Groups of Homomorphisms; Properties of Hom | XI.1; XI2 | 13 |
| Direct Limits; Inverse Limits | XI.3; XI.4 | 14 |
| Tensor Products; Properties of Tensor Products; Flat Modules | XI.5; XI.6; XI.8 | 15 |

**Grading Policy:**

| Assignments | Mid Term Exam | Final Exam |
|---|---|---|
| 30% | 30% | 40% |