

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

Department of Mathematics

MATH 654 (Abstract Algebra)

Semester 241 (Fall 2024)

Prof. Jawad Abuhlail

Description: Selected topics from: Groups, rings, modules, and general algebraic systems.

Prerequisite: MATH 551.

Textbook: J. Golan, *Semirings and their Applications*, Springer (2013).

<https://link-springer-com.kfupm.idm.oclc.org/book/10.1007/978-94-015-9333-5>

Handouts:

H1: J. Abuhlail, *Exact Sequences of Commutative Monoids and Semimodules*, *Homology, Homotopy and Applications* 16 (1) (2014), 199–214.

H2: J. Abuhlail, *Some Remarks on Tensor Products and Flatness of Semimodules*, *Semigroup Forum* 88 (3) (2014), 732-738.

H3: J. Abuhlail and R. G. Noegraha, *On semisimple semirings*, *Comm. Algebra*. 49 (3), 1295-1313 (2021).

Further References:

- 1) M. Gondran and M. Minoux, *Graphs, Dioids and Semirings: New Models and Algorithms*, Springer (2008). <https://link.springer.com/book/10.1007/978-0-387-75450-5>
- 2) P. Grillet, *Abstract Algebra*, 2nd edition, Springer (2007). <https://link.springer.com/book/10.1007/978-0-387-71568-1>
- 3) R. Wisbauer, *Foundations of Module and Ring Theory*, Routledge, 1st edition (2018). <https://www.math.uni-duesseldorf.de/~wisbauer/book.pdf>

Grading:

Midterm Exam	Homework	Projects/Presentations	Poster	Final Exam
20%	15%	25%	10%	30%

Exams:

	Midterm	Final
Date	13.10.2024	TBA

Attendance: Students are expected to attend all lecture classes.

- If a student misses a class, he/she is responsible for any announcement made in that class.
- A DN grade will be awarded to any student who accumulates more than 20% unexcused absences or 33% excused and unexcused absences

Objectives:

- (1) To help students identify the main properties of semirings and semimodules.
- (2) To present the differences in the properties of rings (resp. modules) and their proofs and those of semirings (semimodules) and their proofs.

Learning Outcomes:

Upon successful completion of this course, the student should be able to

Code	CLO
1	Knowledge and Understanding
1.1	Discuss basic examples of proper semirings that are not rings.
1.2	Explain similarities between proper semirings (resp. semimodules) and rings (resp. modules) as well as differences between them.
2	Skills
2.1	Prove and apply basic results on free, projective, and flat semimodules.
2.2	Prove and apply results on injective semimodules.
2.3	Prove and apply results on semisimple semirings, including structure results.
3	Values
	Manage complex ethical and professional issues and make informed judgements on ethical codes and practices.

Detailed Syllabus

Week	Chapter	Title
1	1	Hemirings and semirings: definitions and examples
	3	Building new semirings from old
2	4	Some conditions on semirings
	5	Complemented elements in semirings
September 22-23, 2024		National Day Holidays
3	6	Ideals in semirings
	7	Prime and semiprime ideals in semirings
	8	Factor semirings
4	9	Morphisms of semirings
	10	Kernels of morphisms
5	13	Additively-regular semirings
6	14	Semimodules over semirings
	15	Factor semimodules
7	Handout I	Exact Sequences of semimodules
October 13, 2024		Midterm Exam
8	16	Some constructions for semimodules
9	Handout II	Flat Semimodules
November 10-14, 2024		Midterm Break
10 – 13	17	Free, projective, and injective semimodules
14 - 15	Handout III	Ideal-semisimple and Congruence-semisimple semirings.

Projects:

	I	II	III	Due
P1	Categories and Functors	Limits	Colimits	2.9.2025
P2				
P3				
P4				
P5				