

## Mathematics Department research groups

### 1-Abstract Algebra and Applications Group (3AG)

The group (3AG) is a research group of the Department of Mathematics at the College of Science of Majmaah University. The group performs a research activity in many areas of abstract algebra and its applications in various domains as coding theory (finite fields), cryptography (finite fields), abstract computer science (semirings), genetics (bioderived sets), tropical geometry, etc...

#### Objectives

- 1- Determine some particular properties of morphic groups.
- 2- As an application of the semigroups in computer science; we study the semigroup actions since they are closely related to automata with as a set models; the state of the automaton and the action models transformations of that state in response to inputs. The principal references are:
  - Mati Kilp, Ulrich Knauer, Alexander V. Mikhalev (2000), *Monoids, Acts and Categories: with Applications to Wreath Products and Graphs*, Expositions in Mathematics **29**, Walter de Gruyter, Berlin, [ISBN 978-3-11-015248-7](#).
  - Rudolf Lidl and Günter Pilz, *Applied Abstract Algebra* (1998), Springer, [ISBN 978-0-387-98290-8](#)
- 3- Since the works of Kleene and after those of Samuel Eilenberg, Semirings can be applied in automata theory and formal language, where a comprehensive algebraic theory has been constructed and published in four volumes on *Automata, Languages, and Machines*. The basic algebraic structures used in these books, and the publications of many other researchers, were semirings. Our research is concerned with study some new properties and to study which properties can be obtained in the ternary semirings.
- 4- One of our recent axe of our interest is the study of tropical geometry and our idea is to define general tropical semiring and extract the properties in view of those known in the case of the tropical semifield  $(\mathbb{R}, \max, +)$ .

## 2- Functional Analysis Group (FAG)

The Functional Analysis Group (FAG) is a research group of the Department of Mathematics at the College of Science of Majmaah University. The group performs a research activity in main branches of functional analysis.

### Objectives

Studying MP for some nonlinear systems.

- Applying some methods (Theory of nonlinear operators method - Approximation method - Browder theorem method) to study the existence, non-existence and uniqueness of weak solution for some nonlinear systems.
- Studying Stability properties of weak solution for some nonlinear systems.
- State spaces of operator algebra such as  $C^*$  &  $W^*$  –algebra.
- Studying the pure state spaces of  $C^*$  –algebra.
- Studying the existence and uniqueness of mild solutions to some fractional nonlinear differential equations with discussing when this mild solution will be strong one.
- Studying fractional Euler-Lagrange equations and Hamiltonian equations different senses and discussing their applications.
- Studying the Paly-Weiner theory and its applications.
- Using the Fourier series in Sampling Theorem.

### 3- Fluid Dynamic Group (FDG)

The fluid dynamic Group (FDG) is a research group of the Department of Mathematics at the College of Science of Majmaah University. The group performs a research activity in applied mathematics.

#### Objectives

- Using different Methods to study the effect of radiation and heat generation on natural convection flow.
- Studying the effect of a transverse magnetic field on (free, mixed and natural) convection in a micro polar fluids.
- Studying the effect of chemical reaction on the fluids
- Investigating different methods to solve some problems in Newtonian and non-Newtonian fluids .
- Studying nano fluid in porous media .
- Changing the parameters in Hopf bifurcation

## 4- Operations Research (ORG)

Operations Research Group (ORG) is a research group of the mathematics departments at the College of Science of Majmaah University. The group performs a research activity in both mathematical programming and game theory.

### Objectives

- Applying the different methods such as Nash, Stackelberg, Min-Max, and Nash collative for solving differential game problems and their developed.
- Studying how to find the optimal solutions of semi-infinite programming.
- Studying the different methods for solving a multi-objective programming
- Applying the new concept of E-convexity for treatment non-convex programming.
- Introducing a new concept of generalized convexity, k-rough convex

## 5-Topology and Discrete Mathematics (Rough sets, Fuzzy Sets)

Description: There is currently no machine that can provide us with perfectly certain medical imaging data. Errors from multiple sources including noise, patient movement, and partial volume effect due to limited resolution are polluting the data. Since medical experts rely on these images to bring conclusions about the existence and severity of a potential disease, we aim to provide approaches to convey these errors.

The Rough Set theory is mathematically relatively simple. Despite of this, it has shown its fruitfulness in a variety of data mining areas. Among these are information retrieval, decision support, machine learning, and knowledge based systems. A wide range of applications utilize the ideas of the theory. Medical data analysis, aircraft pilot performance evaluation, image processing, and voice recognition are a few examples.

### Objectives

- Try to investigate some new research directions and building a new hybrid mathematical systems based on Rough , fussy , genetic algorithms , neural networks.
- How to deal with vagueness and ambiguity of data. Such as missing or uncertain data.
- Try to develop applications based on that new hybrid mathematical systems to solve some real life problems. To enhance our quality of life.