**Code and Name:**

**MAT5300 Quaternion Theory**

**Unit:**

Institute of Science, Department of Mathematics

**Details:**

* **Term:** 2023-2024 Spring
* **Status:** Elective
* **Class Level:** 1
* **Credit Hours:** 3-0-0-3
* **ECTS:** 6
* **Language:** Turkish

**Course Instructors:**

* **Course Coordinator:** ...
* **Assistant Instructor:** ...
  + **Phone:** ...
  + **Email:** ...@firat.edu.tr
  + **Social Accounts:** ...

**Weekly Schedule**

| **Monday** | **Tuesday** | **Wednesday** | **Thursday** | **Friday** | **Saturday** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |

**Teaching Method:**  
Each weekly hour will include at least 45 minutes of face-to-face teaching.

**Location:**

* **In-person (YY):** Classroom (To be announced)
* **Remote (UE):** -

**Objective:**

To teach master's and doctoral students working in geometry about quaternions, dual variable functions, spherical motions, and spatial motions, which have numerous applications in astronomy and engineering.

**Materials:**

1. H.H. Hacısalihoğlu, *Geometry of Motion and Quaternions*, Gazi University Press, 1983
2. H.H. Hacısalihoğlu, *Transformations and Geometries in High-Dimensional Spaces*, Ankara University Press
3. H.R. Müller, *Lectures on Kinematics*, Ankara University Press
4. W. Blaschke, *Zur Bewegungsgeometrie auf der Kugel*, Heidelberg Academy

**Student Responsibilities:**

Students are required to attend at least 70% of the classes.

**Weekly Lesson Plan:**

| **Week** | **Topic** | **Methodology** |
| --- | --- | --- |
| 1 | Introduction to the course and key concepts | Face-to-Face |
| 2 | **Basic Concepts**: Quaternion definitions and properties | Face-to-Face |
| 3 | **Quaternion Theory**: Real quaternions | Face-to-Face |
| 4 | **Quaternion Theory**: Algebra of real quaternions and basic operations | Face-to-Face |
| 5 | **Quaternion Theory**: Matrix representation of real quaternions, symplectic geometry | Face-to-Face |
| 6 | **Quaternion Theory**: Basic operations on dual quaternions | Face-to-Face |
| 7 | **Quaternion Theory**: Quaternions, rotation, slip, and screw operators | Face-to-Face |
| 8 | **Quaternion Theory**: Rotations, translations, and screw motions | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Line Geometry**: Linear ray complexes and linear congruences | Face-to-Face |
| 11 | **Line Geometry**: Ruled surfaces | Face-to-Face |
| 12 | **Line Geometry**: Dual vector representation of ruled surfaces | Face-to-Face |
| 13 | **Line Geometry**: One-parameter motions in D-Module and 3-dimensional Euclidean space | Face-to-Face |
| 14 | **Line Geometry**: Canonical coordinate system and axis surfaces | Face-to-Face |

**Assessment and Evaluation:**

| **Method** | **Quantity** | **Weight** |
| --- | --- | --- |
| **Midterm Exam** | 1 | 50% |
| **Quizzes** | None | - |
| **Assignments** | Pre- and post-midterm activities | - |
| **Projects** | None | - |
| **Final Exam** | 1 | 50% |

**Learning Outcomes:**

1. Define fundamental concepts related to real quaternions.
2. Compare the real quaternion system with the real number system.
3. Define concepts related to dual quaternions.
4. Compare real and dual quaternions.
5. Calculate algebraic invariants of ruled surfaces in line geometry.

**Special Notes:**

* **UE:** Remote Education
* **YY:** Face-to-Face Education