**Code and Name:**

**MAT5890 Space Kinematics and Lie Groups**

**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 dual number systems, dual-variable functions, spherical motions, and space kinematics, which are highly applicable in astronomy and engineering, for the benefit of master’s and doctoral students working in geometry.

**Materials:**

1. A. Karger, J. Novak, *Space Kinematics and Lie Groups*, STNL Publishers of Technical Literature, Prague, 1978
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, *On the Geometry of Motion on the Sphere*, Heeidelberger Wiss Math Nat Kl

**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**: Matrices, determinants, vector spaces | Face-to-Face |
| 3 | Group theory fundamentals, curves, and ruled surfaces in differential geometry | Face-to-Face |
| 4 | **Differentiable Manifolds and Lie Groups**: Definitions and theorems | Face-to-Face |
| 5 | Motion on the unit sphere: Spherical motions | Face-to-Face |
| 6 | Euler angles | Face-to-Face |
| 7 | Relationship between orthogonal and unitary matrices | Face-to-Face |
| 8 | Direction cosines and invariants of spherical motion | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | Invariants of a point's trajectory in spherical motion | Face-to-Face |
| 11 | Kinematics of spherical motion | Face-to-Face |
| 12 | Kinematics of space motion: Congruences in three-dimensional Euclidean space and Lie groups | Face-to-Face |
| 13 | Lie algebras in three-dimensional Euclidean space | Face-to-Face |
| 14 | Klein quadrics | 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. Understand matrices, determinants, and vector space concepts.
2. Learn about differentiable manifolds and related theorems.
3. Understand Lie groups, Lie algebras, and related theorems.
4. Learn spherical motion, orthogonal matrices, and unitary matrices.
5. Understand the relationship between orthogonal and unitary matrices and the kinematics of spherical motion.

**Special Notes:**

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