**Code and Name:**

**MAT5320 Theoretical Kinematics**

**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 provide graduate-level students specializing in geometry with knowledge of dual number systems, dual-variable functions, spherical motions, and spatial motions, which are widely applicable in astronomy and engineering.

**Materials:**

1. O. Bottema, B. Roth, *Theoretical Kinematics*, Dover Publications, 1990
2. H.H. Hacısalihoğlu, *Transformations and Geometries in High-Dimensional Spaces*, Ankara University Press
3. H.R. Müller, *Lectures on Kinematics*, Ankara University Press

**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 | **Euclidean Displacement**: Displacement, orthogonal matrices, eigenvalues, and standard representations | Face-to-Face |
| 3 | **Euclidean Displacement**: Cayley formula, indirect motions, transformations, and operators | Face-to-Face |
| 4 | **Instantaneous Kinematics**: Motion definitions, Taylor expansion of orthogonal matrices, angular velocity | Face-to-Face |
| 5 | **Instantaneous Kinematics**: Canonical systems and geometric invariants | Face-to-Face |
| 6 | **Two-Position Theory**: Homologous points, normal planes, homologous planes | Face-to-Face |
| 7 | **Two-Position Theory**: Homologous lines, bisector lines, alternative methods for screw displacement | Face-to-Face |
| 8 | **Three-Position Theory**: Screw triangle, plane at infinity, plane formed by three homologous points | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Three-Position Theory**: Collinear homologous points, lines formed by three homologous points | Face-to-Face |
| 11 | **Three-Position Theory**: Intersections of three homologous points and lines | Face-to-Face |
| 12 | **Three-Position Theory**: Circle axes, radii, angular coordinate systems | Face-to-Face |
| 13 | Applications: Orthogonal screw axes | Face-to-Face |
| 14 | Common perpendicular screw axes and instantaneous states | 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 displacement, orthogonal matrices, their eigenvalues, and standard representations.
2. Learn the Cayley formula, indirect motions, transformations, and operators.
3. Comprehend instantaneous kinematics, two-position theory, and three-position theory.
4. Understand circle axes, radii, and angular coordinate systems.
5. Learn about common perpendicular screw axes and instantaneous states.

**Special Notes:**

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