**Code and Name:**

**MAT5350 Isometries and Groups in Semi-Riemannian Geometry**

**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 foundational knowledge on Riemannian and Lorentz geometries, relativity theory, symmetry and constant curvatures, isometries, semi-orthogonal groups, some isometric groups, Schwarzschild geometry, and Lie groups.

**Materials:**

* Barret O’Neill, *Semi-Riemann Geometry with Application to Relativity*, Academic Press Inc., New York, 1983

**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 | **Riemannian and Lorentz Geometries**: Gauss lemma, convex open sentences | Face-to-Face |
| 3 | **Distance Concept**: Arc length, Riemannian distance | Face-to-Face |
| 4 | **Lorentz Causal Characters**: Timelike cones, local Lorentz geometry | Face-to-Face |
| 5 | **Geodesics**: Geodesics in hyperquadratics and surfaces, completeness, and extensibility | Face-to-Face |
| 6 | **Relativity Theory**: Relativity theory foundations | Face-to-Face |
| 7 | **Minkowski Geometry**: Minkowski spacetime, Minkowski geometry | Face-to-Face |
| 8 | **Curvature**: Symmetry and constant curvatures, Jacobi fields, locally symmetric manifolds | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Isometry**: Isometries of normal neighborhoods, symmetric spaces | Face-to-Face |
| 11 | **Isometries**: Basic concepts and applications | Face-to-Face |
| 12 | **Groups**: Semi-orthogonal groups and some isometric groups | Face-to-Face |
| 13 | **Schwarzschild Geometry**: Lie groups and Lie algebras | Face-to-Face |
| 14 | **Lie Exponential Transformations**: Classical Lie groups | 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 arc length and Riemannian distance.
2. Learn Lorentz causal characters, timelike cones, and local Lorentz geometry.
3. Understand geodesics in hyperquadratics and surfaces, completeness, and extensibility.
4. Learn relativity theory, Minkowski spacetime, and Minkowski geometry.
5. Grasp symmetry and constant curvatures, Jacobi fields, and locally symmetric manifolds.

**Special Notes:**

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