**Code and Name:**

**MAT5340 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 teach the fundamental properties of Semi-Riemannian geometry.

**Materials:**

* Barret O’Neill, *Semi-Riemann Geometry with Applications to Relativity*, Academic Press, 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 | **Basic Concepts**: Differentiable manifolds and transformations, tangent vectors, curves | Face-to-Face |
| 3 | **Manifolds**: Vector fields, biforms, submanifolds, immersions, and submersions | Face-to-Face |
| 4 | **Manifolds and Tensors**: Topology of manifolds, integral curves, tensors, symmetric bilinear forms | Face-to-Face |
| 5 | **Lorentz Manifold and Isometry**: Scalar product, Lorentz manifold, semi-Euclidean space, isometry in Semi-Riemannian manifolds | Face-to-Face |
| 6 | **Connection and Translation**: Levi-Civita connection, parallel translation, exponential transformation | Face-to-Face |
| 7 | **Curvature**: Riemann curvature tensor, sectional curvature, semi-Riemannian surfaces | Face-to-Face |
| 8 | **Curvature**: Differential operators, Ricci and scalar curvature, semi-Riemannian product manifolds, local isometries | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Connection**: Semi-Riemannian submanifolds: Tangents, normals, and reduced connections | Face-to-Face |
| 11 | **Geodesics**: Geodesics in submanifolds, totally geodesic submanifolds | Face-to-Face |
| 12 | **Hypersurfaces**: Semi-Riemannian and totally umbilical hypersurfaces, hyperquadrics | Face-to-Face |
| 13 | **Connection**: Codazzi equation, normal connection, congruence theorem | Face-to-Face |
| 14 | **Immersion**: Isometric immersions, two-parameter transformations | 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. Learn the basic concepts of Semi-Riemannian geometry.
2. Understand the topology of manifolds and the properties of tensors.
3. Learn the Levi-Civita connection, parallel translation, and exponential transformations.
4. Understand Semi-Riemannian submanifolds, tangents, normals, and reduced connections.
5. Learn isometric immersions and two-parameter transformations.

**Special Notes:**

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