**Code and Name:**

**MAT5400 Advanced Differential 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 knowledge of tensors and tensor algebra and introduce the algebraic aspects of differential geometry, including Lie groups and Lie algebras.

**Materials:**

1. B. O'Neill, *Elementary Differential Geometry*, Revised 2nd Edition, 2006
2. H.H. Hacısalihoğlu, *Advanced Differential Geometry and Introduction*, Fırat University Press, 1980

**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 | **Inner Product Spaces and Dual Vector Spaces**: Definitions and theorems | Face-to-Face |
| 3 | **Orthogonal Group and Self-Adjoint Transformations**: Definitions and properties | Face-to-Face |
| 4 | **Multilinear Algebra**: Definitions and properties | Face-to-Face |
| 5 | **Differentiable Manifolds**: Differentiable structures and algebraic concepts on manifolds | Face-to-Face |
| 6 | **Algebra of Multilinear Functions**: ppp-linear functions and their vector spaces | Face-to-Face |
| 7 | **Tensors and Tensor Algebra**: Tensor products of vector spaces, tensor types | Face-to-Face |
| 8 | **Exterior Product and Vector-Tensor Inner Product**: Definitions and theorems | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Symmetric Product and Symmetric Algebra**: Definitions and properties | Face-to-Face |
| 11 | **Isomorphic Tensor Spaces and Tensor Products of Linear Transformations**: Theorems and examples | Face-to-Face |
| 12 | **Lie Groups and Lie Algebras**: Groups, topological spaces, differentiable groups, Lie subgroups, Lie algebras | Face-to-Face |
| 13 | **Matrix Lie Groups and Frame Bundles**: Definitions and theorems | Face-to-Face |
| 14 | **Examples of Lie Groups and Lie Algebras**: General linear group and vector-valued forms | 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 on manifolds.
2. Understand tensors and tensor spaces.
3. Define exterior product and exterior algebra.
4. Comprehend symmetric product and symmetric algebra.
5. Learn tensor products of linear transformations.

**Special Notes:**

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