**Code and Name:**

**MAT5310 Differential Forms**

**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 understand exterior algebra, manifolds, integrals, and their applications in Euclidean space.

**Materials:**

1. H. Flanders, *Differential Forms with Applications to the Physical Sciences*, Dover, 1989
2. V. Guillemin, P.J. Haine, *Differential Forms*, 2018
3. D. Bachman, *A Geometric Approach to Differential Forms*, 2003

**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 | **Exterior Algebra**: Space of ppp-vectors, determinants, exterior products, linear transformations | Face-to-Face |
| 3 | **Exterior Algebra**: Inner product spaces, inner products of ppp-vectors, star operator | Face-to-Face |
| 4 | **Exterior Derivative**: Differential forms, exterior derivative, transformations, coordinate changes | Face-to-Face |
| 5 | **Exterior Derivative**: Inverse of Poincaré lemma and examples | Face-to-Face |
| 6 | **Manifolds and Integrals**: Manifolds, tangent vectors, differential forms, integrals of forms | Face-to-Face |
| 7 | **Manifolds and Integrals**: Stokes’ theorem, de Rham’s theorems | Face-to-Face |
| 8 | **Applications in Euclidean Space**: Hopf invariant | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Applications in Differential Geometry**: Surfaces and hypersurfaces | Face-to-Face |
| 11 | **Applications in Differential Geometry**: Riemannian geometry, local theory | Face-to-Face |
| 12 | **Applications in Group Theory**: Matrix groups and examples | Face-to-Face |
| 13 | **Applications in Group Theory**: Bi-invariant forms | Face-to-Face |
| 14 | **Applications in Physics**: Hamiltonian systems | 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 equivalence principles, manifolds, tensors, and forms.
2. Understand Riemann curvature, Ricci tensor, Ricci scalar, and Einstein field equations.
3. Learn differential forms, exterior derivatives, transformations, and coordinate changes.
4. Understand Stokes’ theorem, de Rham’s theorems, Hopf invariant, and Gauss integrals.
5. Learn Ampère's laws, heat equations, and Frobenius integral theorem.

**Special Notes:**

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