**Code and Name:**

**MAT5070 Hilbert Space and Its Properties**

**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:**

This course aims to provide foundational knowledge and applications of Hilbert spaces.

**Materials:**

1. *Introduction to Hilbert Spaces*, L. Debnath, Piotr Mikusinski
2. *A First Course in Sobolev Spaces*, G. Leini

**Student Responsibilities:**

Students are required to attend at least 70% of the classes.

**Weekly Lesson Plan:**

| **Week** | **Topic** | **Methodology** |
| --- | --- | --- |
| 1 | **Introduction to the Course**: Objectives, content, resources, and importance of outcomes | Face-to-Face |
| 2 | **Introduction to Hilbert Spaces**: Vector spaces, normed spaces, Banach spaces | Face-to-Face |
| 3 | **Linear Transformations**: Properties and applications | Face-to-Face |
| 4 | **Inner Product Spaces**: Theorems and examples | Face-to-Face |
| 5 | **Hilbert Spaces**: Fundamental theorems | Face-to-Face |
| 6 | **Orthogonal and Orthonormal Systems**: Trigonometric Fourier transforms | Face-to-Face |
| 7 | **Orthogonal Complements and Projections**: Linear functionals | Face-to-Face |
| 8 | **Riesz Representation**: Operator examples | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Bilinear Functionals**: Quadratic forms | Face-to-Face |
| 11 | **Operators in Hilbert Spaces**: Adjoint, self-adjoint, and invertible operators | Face-to-Face |
| 12 | **Operators in Hilbert Spaces**: Normal, isometric, and unitary operators | Face-to-Face |
| 13 | **Operators in Hilbert Spaces**: Positive and compact operators | Face-to-Face |
| 14 | **Applications of Hilbert Spaces**: Eigenvalues, eigenvectors, spectral decomposition, and unbounded operators | 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 vector spaces, normed spaces, and Banach spaces.
2. Learn the concept of Hilbert spaces.
3. Grasp orthogonal and orthonormal systems, as well as trigonometric Fourier transforms.
4. Learn adjoint and self-adjoint operators and their types.
5. Understand eigenvalues and eigenvectors.

**Special Notes:**

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