**Code and Name:**

**MAT5100 Advanced Functional Analysis**

**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 definitions and theorems of functional analysis.

**Materials:**

1. E. Kreyszing, *Introduction to Functional Analysis with Applications*
2. Yüksel Soykan, *Functional Analysis*
3. Mustafa Bayraktar, *Functional Analysis*
4. Ana M. Aguilera, Manuel Escabias et al., *Advanced Functional Analysis*
5. Erdoğan Şuhubi, *Functional Analysis*

**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, key topics; Metric spaces: properties | Face-to-Face |
| 2 | Metric Spaces: Open and closed sets, neighborhoods, convergence, Cauchy sequences, completeness | Face-to-Face |
| 3 | Normed and Banach Spaces: Vector spaces, properties of finite-dimensional spaces | Face-to-Face |
| 4 | Normed and Banach Spaces: Compactness, linear operators, linear functionals, dual space | Face-to-Face |
| 5 | Inner Product Spaces and Hilbert Spaces: Orthogonal complements, direct sums | Face-to-Face |
| 6 | Inner Product Spaces and Hilbert Spaces: Orthonormal sets, Legendre, Hermite, Laguerre polynomials | Face-to-Face |
| 7 | Inner Product Spaces and Hilbert Spaces: Self-adjoint, unitary, normal operators | Face-to-Face |
| 8 | Fundamental Theorems: Zorn's lemma, Hahn-Banach theorem | Face-to-Face |
| 9 | Midterm Exam | Face-to-Face |
| 10 | Adjoint operators, reflection spaces, uniform boundedness theorem | Face-to-Face |
| 11 | Weak and strong convergence, sequences of operators and functionals | Face-to-Face |
| 12 | Numerical integration, open mapping theorem | Face-to-Face |
| 13 | Closed operators, closed graph theorem, Banach fixed-point theorem | Face-to-Face |
| 14 | Applications of Banach fixed-point theorem to integral and differential equations | 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 metric spaces, vector spaces, normed spaces, and Banach spaces.
2. Learn the concepts of operators, functionals, inner product spaces, and Hilbert spaces.
3. Master Legendre, Hermite, and Laguerre polynomials and fundamental theorems of Banach spaces.
4. Learn adjoint operators, reflection operators, and concepts of weak and strong convergence.
5. Understand closed linear operators and apply fundamental theorems of normed and Banach spaces.

**Special Notes:**

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