**Code and Name:**

**MAT5790 Inverse Problems of Spectral 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 provide an understanding of the inverse problems and their properties in spectral theory.

**Materials:**

1. B.M. Levitan, *Inverse Sturm-Liouville Problems*, VNU Science Press, 1987
2. J. Pöschel, E. Trubowitz, *Inverse Spectral Theory*, Academic Press, 1987

**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 | Inverse problems in Sturm-Liouville theory: Conceptual framework based on spectral data | Face-to-Face |
| 3 | Asymptotics of spectral parameters in eigenvalue problems | Face-to-Face |
| 4 | Uniqueness theorem: Spectral data from eigenvalues and eigenfunctions | Face-to-Face |
| 5 | Diffusion operator: Overview and inverse problem | Face-to-Face |
| 6 | Dirac operator: Overview and inverse problem | Face-to-Face |
| 7 | Zeros (nodal points) of eigenfunctions and nodal lengths | Face-to-Face |
| 8 | Uniqueness of potential function in Dirichlet boundary Sturm-Liouville problems | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | Potential function uniqueness for separable boundary problems using nodal points | Face-to-Face |
| 11 | Determining potential functions in Sturm-Liouville problems using nodal points | Face-to-Face |
| 12 | Inverse periodic Sturm-Liouville problems | Face-to-Face |
| 13 | 1D p-Laplacian problem and inverse nodal problem | Face-to-Face |
| 14 | Parameter-dependent p-Laplacian problem | 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 the logic and solutions of inverse problems in Sturm-Liouville theory.
2. Learn the asymptotics of spectral data in eigenparameter problems.
3. Analyze the uniqueness theorem in Sturm-Liouville problems.
4. Learn about eigenfunction zeros (nodal points) and nodal lengths.
5. Solve inverse periodic Sturm-Liouville problems and p-Laplacian problems.

**Special Notes:**

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