**Code and Name:**

**MAT5480 Numerical Solutions of Ordinary Differential Equations**

**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 analyze numerical methods for solving ordinary differential equations and demonstrate their mathematical derivation. The course aims to equip students with the skills to solve differential equations numerically and understand the mathematical and computational challenges involved.

**Materials:**

1. J.R. Dormand, *Numerical Methods for Differential Equations: A Computational Approach*, CRC Press
2. S. Larsson, V. Thomee, *Partial Differential Equations with Numerical Methods*, Springer Verlag
3. M.S. Gockenbach, *Partial Differential Equations: Analytical and Numerical Methods*, SIAM
4. H.P. Langtangen, *Computational Partial Differential Equations: Numerical Methods and Diffpack Programming*, Springer Verlag

**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 | **Introduction to ODEs**: Existence and uniqueness theorem | Face-to-Face |
| 3 | **Basic Methods**: Local definition of single-step methods, finite Taylor series methods | Face-to-Face |
| 4 | **Basic Methods**: Runge-Kutta methods, predictor-corrector methods | Face-to-Face |
| 5 | **General Definition of Single-Step Methods**: Stability, convergence, asymptotic errors | Face-to-Face |
| 6 | **Basic Methods**: Euler method, Picard method | Face-to-Face |
| 7 | **Multi-Step Methods**: Local description, open and closed methods | Face-to-Face |
| 8 | **Multi-Step Methods**: Adams-Bashforth method, Adams-Moulton method, predictor-corrector methods | Face-to-Face |
| 9 | **Midterm Exam** | Face-to-Face |
| 10 | **Higher-Order ODEs**: General description of multi-step methods, linear difference equations | Face-to-Face |
| 11 | **Basic Methods**: Milne and Heun methods | Face-to-Face |
| 12 | **Basic Methods**: Stiff problems, multi-step methods | Face-to-Face |
| 13 | **Basic Methods**: A-stability | Face-to-Face |
| 14 | **Multi-Step Methods**: Local accuracy and polynomial degree of multi-step methods | 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. Develop numerical integration and differentiation methods and solve nonlinear systems.
2. Understand the mathematical concepts of numerical methods for solving ODEs.
3. Learn methods for solving initial value problems for ODEs.
4. Use software packages like Mathematica to solve initial and boundary value problems.
5. Understand multi-step methods and their properties.

**Special Notes:**

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