科目ナンバリング	G-LAS12 80038 SE76						
授業科目名 <英訳>	Mathematics and Numerical Computing Mathematics and Numerical Computing			担当者所属 職名・氏名	工学研究科　教授　外輪　健一郎 工学研究科　助教　Oh Tae Hoon		
群	大学院横断教育科目群	分野(分類)	統計・情報・データ科学系	使用言語	英語		
旧群		単位数	1.5単位	週コマ数	1コマ	授業形態	演習（対面授業科目）
開講年度・開講期	2024・後期	曜時限	火4	配当学年	大学院生	対象学生	理系向

（工学研究科の学生は，全学共通科目として履修登録できません。所属部局で履修登録してください。）

[授業の概要・目的]

The aim is to describe methodologies using scientific programming software (Python) to solve typical numerical computation problems encountered in the field of engineering and science. While exercises often revolve around problems in chemical engineering, the final part involves participants bringing numerical computation tasks related to their research projects. Each individual uses Python to find solutions to their respective problems and engages in group discussions to explore the significance of these solutions. Through these exercises, participants acquire skills in programming techniques and their application in research.

[到達目標]

The goal is to comprehend Python programming code, attain a basic proficiency in programming using Python, learn various numerical computation methods, and acquire the ability to program, compute, and analyze solutions for self-defined problems in this field.

[授業計画と内容]

(1) Introduction to Python
Learn how to get started with Python: simple arithmetic operations, creating loop statements, making vectors with numpy, and visualization with matplotlib.

(2) Solving Algebraic Equations
Learn Bisection, Newton, and Secant methods as numerical computational methods for solving linear and nonlinear algebraic equations.

(3) Numerical Integration
Learn how to numerically integrate arbitrary nonlinear functions. As numerical calculation methods, we will discuss trapezoidal and Simpson's rule and Gauss quadrature.

(4) Solving Ordinary Differential Equations
Learn how to numerically solve linear and nonlinear ordinary differential equations. As numerical calculation methods, Euler, implicit first order, and RKG methods will be discussed.

(5) Solving Partial Differential Equations
Learn how to numerically solve partial differential equations. We will discuss the difference between FDM and FEM and apply them to a simple one-dimensional example.

(6) Introduction to Eigenvalue Problems
Learn about eigenvalues and their mathematical properties. Furthermore, create a program using matplotlib to visualize eigenvectors, deepening the understanding of the significance of eigenvalues.

(7) Computation of Eigenvalues

Mathematics and Numerical Computing(2)へ続く↓↓↓

Mathematics and Numerical Computing(2)

Learn fundamental methods to find a single eigenvalue of a matrix. Discuss Gershgorin's theorem, power iteration method, inverse power iteration method, and deflation method.

(8) Computation of Eigenvalues
Study the QR method, which can simultaneously determine all eigenvalues of a matrix.

(9) Solution Methods for Algebraic Equations
Understand the relationship between algebraic equations and eigenvalue problems. Learn methods to find all solutions of algebraic equations using the properties of eigenvalues.

(10) Principal Component Analysis
Learn principal component analysis as an application of eigenvalues. PCA is a prominent data compression technique widely used in engineering and scientific fields.

(11) Presentation
Each participant selects a topic of interest, performs calculations related to it using Python, and presents the results.

[履修要件]

特になし

[成績評価の方法・観点]

Attendance, assignment and presentation will count.

[教科書]

Handouts will be given in each lecture.

[参考書等]

（参考書）
授業中に紹介する

[授業外学修（予習・復習）等]

Assignments will be given as necessary.

[その他（オフィスアワー等）]

This course is offered every other year.