

# Numerical Analysis

Syllabus Number

3F219

Special Subjects

Elective 2 credit

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## 1. Course Description

Techniques for finding solutions to problems that cannot solve equations analytically, and for analyzing differential and integral problems by numerical calculation are widely used not only in science and engineering fields.

In this course, you will study numerical analysis methods. Also, you will use computers actually to solve problems in order to understand analysis methods deeply.

You will acquire knowledge and skills on DP3 of diploma policies.

## 2. Course Objectives

The goal is to understand basic analysis methods for numerical calculation using a computer. You become able to explain the analysis methods, and analyze by computer.

## 3. Grading Policy

Your grade will be assessed based on the scores of exercise problems (60%) and final exams (40%). LMS posts class materials, receives reports, and provides feedback.

## 4. Textbook and Reference

Textbook

No text book, but reference books (in Japanese) are as follows:

Reference

趙華安 Excelによる数値計算法 共立出版、ISBN-13: 978-4320016507

Fire Dynamics Simulator User's Guide, Sixth Edition, NIST Special Publication 1019, Kevin McGrattan et al., <http://dx.doi.org/10.6028/NIST.SP.1019>

Fire Dynamics Simulator Technical Reference Guide, Volume 1: Mathematical Model, Sixth Edition, NIST Special Publication 1018-1, Kevin McGrattan et al., <http://dx.doi.org/10.6028/NIST.SP.1018>

<https://pages.nist.gov/fds-smv/>

It is recommending that you collect information using library materials and internet.

And you can find class materials on LMS.

## 5. Requirements(Assignments)

It is important to have a thorough understanding in mathematics class, especially calculus.

For the preparation, you should study in advance for each class based on reference books, library materials, and materials collected via the Internet. (1.5 hours)

After the class, you should review and work on exercise problems of analysis by computer for report in order to improve your understanding. (1.5 hours)

## 6. Note

Excel will be used for computer analysis until the 11th lecture. From the 12th lecture, open source fluid analysis software (FDS) will be used.

## 7. Schedule

- [1] Proceeding of classes, overview of numerical simulation, history of computers
- [2] Numerical solution: Newton method
- [3] Numerical solution: Regula falsi method
- [4] Matrix calculation: Addition / Subtraction, Multiplication, Determinant calculation, Inverse matrix
- [5] Solve simultaneous equations: Gauss-Jordan elimination
- [6] Function interpolation method and approximate: Lagrange Interpolation
- [7] Function interpolation method and approximate: Least Squares method
- [8] Numerical integration: Trapezoidal rule method
- [9] Numerical integration: Simpson rule
- [10] Ordinary differential equations: Euler method
- [11] Ordinary differential equations: Runge-Kutta method
- [12] Fire Dynamics Simulator (FDS) : Overview and setup
- [13] Fire Dynamics Simulator (FDS) : Creating an input file and Execution of simulation
- [14] Fire Dynamics Simulator (FDS) : Performing thermal-fluid analysis
- [15] Fire Dynamics Simulator (FDS) : Performing thermal-fluid analysis advanced