



## Faculty of Eng. & Natural Sci.

ENS409-202101

Numerical Analysis

### Instructor

Name	Email	Office	Phone	Web	Office Hours
Mustafa Ünel	<a href="mailto:munel@sabanciuniv.edu">munel@sabanciuniv.edu</a>	FENS-1066	9549	<a href="http://people.sabanciuniv.edu/munel">http://people.sabanciuniv.edu/munel</a>	Before and after classes, or by appointment.

### Course Content

This course covers the use of numerical computing techniques for mathematical and scientific problems. Topics include: floating-point representation, approximations and computer arithmetic, error analysis, conditioning and stability, Taylor series, roots of nonlinear equations, Newton's method, curve fitting and interpolation solution to systems of linear equations using techniques such as LU decomposition, Gaussian elimination, Jacobi, Gauss-Seidel Iteration, eigenvalue problems, numerical integration and solutions to differential equations.

### Objectives

To provide a solid background for understanding and implementing numerical analysis and related algorithms.

### Recommend or Required Reading

#### Textbook

Numerical Analysis, J. Douglas Faires and Richard L. Burden, Thomson Press, 2004 (9th edition is available as pdf)

#### Optional Readings

- Applied Numerical Methods with MATLAB for Engineers and Scientists, S. C. Chapra, 3rd Edt., Tufts University, McGraw-Hill, 2012.

- Numerical Methods for Engineers, S. C. Chapra and R. P. Canale, 6th Edition, McGraw-Hill, 2010
- Numerical Methods using MATLAB, J.H. Mathews & K.D. Fink, 4th Edt., Pearson, 2004.

## Assessment Methods and Criteria

	Percentage (%)	Number of assessment methods
Final	30	
Midterm	30	1
Individual Project	30	5
Homework	10	5

## Course Outline

Analytical and exact methods can provide solutions for a limited class of problems. Practical real-life problems often require computational solutions of complicated mathematical problems for arbitrarily shaped geometries and complicated material properties. Computers and numerical methods provide an alternative for such complicated problems. This course will introduce numerical analysis for modeling various scientific problems. The advantages and drawbacks of various computational techniques will be provided. Students will gain hands-on experience for numerical solutions by developing simple computer codes.

### Topics:

- Introduction to Numerical Methods
- Mathematical Preliminaries and Error Analysis
- Solution of Nonlinear Equations
- Interpolation
- Least Squares Regression
- Matrices and Systems of Linear Equations
- Numerical Differentiation and Integration
- Ordinary and Partial Differential Equations

## Learning Outcomes

- Apply the basic numerical concepts such as error analysis, round off error, subtractive cancellation, and error magnification.
- Apply fundamental numerical analysis tools and identify their limitations
- Apply these basic numerical principles to model and analyze engineering problems.
- Gain hand on experience by developing computational tools for applied numerical problem

## Course Policies

- Cheating is absolutely subject to a disciplinary action and a null grade.
- Make-up only for official excuses.