General Information:

Name of Course: NUMERICAL METHODS FOR CIVIL ENGINEERING

Course Code: MSM084AN

Semester: 1st
Number of Credits: 3
Allotment of Hours per Week: 3 Laboratories /Week
Evaluation: Examination (with grade)
Prerequisites: **Structural Analysis (BSc), Mathematics (BSc)**

Instructor: **Prof Dr Anikó CSÉBFALVI, full professor**
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Introduction, Learning Outcomes:
Numerical methods provide a way for the engineer to translate the language of mathematics and physics into information that may be used to make engineering decisions. Often, this translation is implemented so that calculations may be done by computers. The types of problems that you encounter as an engineer may involve a wide variety of mathematical phenomena, and hence it will benefit you to have an equally wide range of numerical methods with which to approach some of these problems. This course will provide you with an introduction to several of those numerical methods which you may then find opportunity to practice later in the curriculum.

Upon successful completion of this course, the student will be able to:

1. Define and identify special types of matrices.
2. Perform basic matrix operations.
3. Define and solve linear systems.
4. Define interpolation.
5. Define and use direct interpolation to approximate data and find derivatives.
6. Define and use Newton's divided difference method of interpolation.
7. Define and use Lagrange and spline interpolation.
8. Implement Euler's methods for solving ordinary differential equations.
9. Investigate how step size affects accuracy in Euler's method.
10. Implement and use the Runge-Kutta 2nd order method for solving ordinary differential equations.
11. Apply the shooting method to solve boundary-value problems.
12. Describe the finite different method for one-dimensional problems

Requirements for Completion: This course contains 13 units of selected topics of numerical methods listed above. In order to complete this course, you will need to work through each selected unit and all of its assigned materials in the TEXTBOOK: NUMERICAL METHODS WITH APPLICATIONS (Authors: Autar K Kaw | Co-Author: Egwu E Kalu, Duc Nguyen) available: http://nm.mathforcollege.com/topics/textbook_index.html.. Each unit is accompanied by lectures, readings, and exercises. Please give time to these; they are the best way to test your knowledge and learn.

In order to take this course, you must: Have access to a computer, frequent broadband Internet access, and ability to download and save files and documents to a computer. Using your personal code, all of the computer skills are available in the course room: PTE MIK, A-117.

You will also need to complete two graded **Midterm Test Examples** and the **Final Exam** (with grade).

General Course Description and Main Content:

Brief Syllabus: The purpose of this course is to introduce students to a basic knowledge of numerical methods and learn its application for engineering problems. The selected topics are focusing for engineering problems and related computational methods. The solution methods are applied and demonstrated with help of Wolfram Mathematica (© 2015 Wolfram. All rights reserved). Legal licensed version available in room A 117. Student version: http://www.wolfram.com/solutions/education/students/.

In order to tackle the different knowledge of students in mathematics and structural analysis, a short description is required about the related engineering problems. However, chapters of the proposed TEXTBOOK: NUMERICAL METHODS WITH APPLICATIONS (Authors: Autar K Kaw | Co-Author: Egwu E Kalu, Duc Nguyen) (http://nm.mathforcollege.com/topics/textbook_index.html) freely available, the attendance of the lectures and personal activity is obligatory. With the usage of the settled computers, the students are able to follow of the topic of the recent presentation and its application as well.

Schedule:
Continuous learning of students is **controlled two times** during the semester. Therefore, two parts is distinguished and controlled:

- **First part** of the semester content basics of matrix computation, linear equilibrium systems, and interpolation methods, subsequently unit 1-7 (Week 1-7).
- **Second part** of the semester content basics of ordinary and partial differential equations, solution methods of ordinary differential equations, Euler's method, Runge-Kutta 2nd order method, finite different, and finite element method, subsequently unit 8-12, (Week 10-14).

Each part closes with a graded **Midterm Test Example** from the predetermined topics of the given units. **Location** of the Midterm Test Example: Room A117. **Time**: Week 8 (**1st Midterm Test Example**) and Week 15 (**2nd Midterm Test Example**).

Methodology:
The course is based on individual computational skills with regular consultations and presentations.

Studio Culture:
The course is based on through collaboration, participation and discussions trough lessons. This is an interaction between Students and Faculty; used the teaching methods like 'Problem-based learning' and 'learning-by-doing'. The communication and work should be reflect a respect for fellow students and their desire to work with regard to noise levels, noxious fumes, etc – from each site of participants.

Attendance:
Attending is required all classes, and will impact the grade (max. 10%). Unexcused absences will adversely affect the grade, and in case of absence from more than 30% of the total number of lesson will be grounds for failing the class. To be in class at the beginning time and stay until the scheduled end of the lesson is required, tardiness of more than 20 minutes will be counted as an absence. In the case of an illness or family emergency, the student must present a valid excuse, such as a doctor's note.

Evaluation + Grading
Grading will follow the course structure with the following weight: **1st Midterm Test Example - 45%, 2nd Midterm Test Example - 45%.** The remaining 10% will be assessed according to participation, progress, effort and attitude. Please note that attendance will adversely affect one's grade, both in direct grade reduction and in missing work in the development of a project. The final grade will be based on the following guidelines:

Grading Scale:

Numeric Grade:	5	4	3	2	1
Evaluation in points:	89%-100%	77%-88%	66%-76%	55%-65%	0-54%

5. Outstanding work. Execution of work is thoroughly complete and demonstrates a superior level of achievement overall with a clear attention to detail in the production of drawings, models and other forms of representation. The student is able to synthesize the course material with new concepts and ideas in a thoughtful manner, and is able to communicate and articulate those ideas in an exemplary fashion in.

4. High quality work. Student work demonstrates a high level of craft, consistency, and thoroughness throughout drawing and modelling work. The student demonstrates a level of thoughtfulness in addressing concepts and ideas, and participates in group discussions. Work may demonstrate excellence but less consistently than an '5' student.

3 Satisfactory work. Student work addresses all of the project and assignment objectives with few minor or major problems. Graphics and models are complete and satisfactory, exhibiting minor problems in craft and detail.

2. Less than satisfactory work. Graphic and modelling work is substandard, incomplete in significant ways, and lacks craft and attention to detail.

1. Unsatisfactory work. Work exhibits several major and minor problems with basic conceptual premise, lacking both intention and resolution. Physical representation in drawing and models is severely lacking, and is weak in clarity, craft and completeness.

Students with Special Needs:
Students with a disability and needs to request special accommodations, please, notify the Deans Office. Proper documentation of disability will be required. All attempts to provide an equal learning environment for all will be made.

Readings and Reference Materials:

TEXTBOOK: NUMERICAL METHODS WITH APPLICATIONS (Authors: Autar K Kaw | Co-Author: Egwu E Kalu, Duc Nguyen) (http://nm.mathforcollege.com/topics/textbook_index.html).
This book entitled Numerical Methods with Applications is written primarily for engineering and science undergraduates taking a course in Numerical Methods. The textbook offers a unique treatise to numerical methods which is based on a holistic approach and short chapters. This book is a product of many years of work on educational projects funded since 2002 by the National Science Foundation.

Features:

1. Examples of real-life applications are available from seven different engineering majors.
2. Each chapter is followed by multiple-choice questions.
3. Supplemental material such as primers on differential and integral calculus, and ordinary differential equations are available on the web.
4. The book has a state-of-art dedicated open courseware website with extra examples, PowerPoint presentations, worksheets in MATLAB, MATHEMATICA, Maple and MathCAD, anecdotes, eBooks, and blogs.

To access the website, go to http://numericalmethods.eng.usf.edu

To access the blog go to http://autarkaw.wordpress.com.