Syllabus: Application of Software Tools


Instructors

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Course goals

The students are able to design and implement structured programs using the object-oriented paradigm and know how to apply different simulation programs. The students have the ability to apply MATLAB to distinguish mathematical problems as well as the finite volume software OpenFoam in order to simulate fluid flows in technical apparatus. Additionally, the students have the ability to apply a semi-commercial finite element software to simulate structural components of wind power plants and to transfer their knowledge to classical commercial finite element packages as e.g. Abaqus, ANSYS, Nastran. In particular, geometrical modeling, meshing, static and dynamic analyses and the interpretation of the results are familiar to the students.

Pre-requisites

none

Seminar structure, seminar location and times

The module Application of Software Tools is divided in four unit topics. These unit topics will be taught by different lecturers and in different teaching concepts - (1) synchronous and (2) asynchronous. In the synchronous teaching concept the lecturer will be held a live Online Session via Adobe Connect in ecampus (unit 9-12). In the asynchronous teaching concept the lecturer will provided the students with tutorial videos and homework assignments (unit 1-8 and 13-16).

All questions on understanding the material should be directed to your fellow students in the online forums first! Any questions which could not be answered already by your classmates are answered by the lectures via email or online consultation hours.

Participation requirements

Unit 1-8: Students can view the video tutorials according to the following unit plan. Additional private study will have to be made as mentioned in the video tutorials. Every unit will have a graded homework.

Unit 9-12: Students can take place in the live lectures and can view the video tutorials according to the following unit plan. Additional private study will have to be made as mentioned in the video tutorials. Every unit will have a graded homework.

Unit 13-16: No real-time class seminars, but online consultation hours announced by the lecturer.
Texts, reading and other materials

Unit 1-12: Readings will be made available in moodle or require publically available external web resources.

Unit 13-16: Slides are posted on Moodle. Additional materials are available on external web resources.

Hardware and software requirements

Unit 1-4: All students need access to a computer with the rights to install the Java JDK and eclipse, or have both already installed. Installation and usage will be dealt with in the first unit.

Unit 5-12: All students need access to a computer with the software “Matlab”, or to a computer with a terminal (windows: putty, linux or mac: terminal) to get access to our Matlab server.

Unit 13-16: All students need access to a computer with the rights to install a Virtual Box in order to use the operation system Ubuntu (linux). Installation and usage will be explained in the first unit. The use of a text processing system is recommendable.

Art of Examination

Every part of the module will be graded separately.
Unit 1-12 will have a graded homework for each unit.
Unit 13-16 will have one graded homework.
The module grade will the average of the grades of the four parts.
Grading policy

The grading scale used in this course is the same as for all WES courses. For all single assignments, the following scale is used:

<table>
<thead>
<tr>
<th>Category</th>
<th>Grade range</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td>1,0 - 1,3</td>
<td>Excellent performance</td>
</tr>
<tr>
<td>Good</td>
<td>1,7 - 2,3</td>
<td>Performance significantly above average</td>
</tr>
<tr>
<td>Satisfactory</td>
<td>2,7 - 3,3</td>
<td>Average performance</td>
</tr>
<tr>
<td>Sufficient</td>
<td>3,7 - 4,0</td>
<td>Performance which, despite some shortcomings, meets the minimum standards of the course</td>
</tr>
<tr>
<td>Fail</td>
<td>5,0</td>
<td>Does not meet minimum course requirements</td>
</tr>
</tbody>
</table>
**Unit 1**
**Nov. 03. – 07.**  
**Object - oriented Programming with Java**

**Content**  
The first unit will cover the requirements for using eclipse to write JAVA programs as well as a first JAVA “Hello World”-program. Additionally JAVA variable types and handling as well as output via the console will be explained.

**Homework**  
Write a simple JAVA program with mathematical operations using different variable types.

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**Unit 2**
**Nov. 10. – 14.**  
**Object - oriented Programming with Java**

**Content**  
Unit 2 will cover different methods to control program flow: IF-Statements and different types of loops.

**Homework**  
Write a JAVA program with loops and IF-statements.

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**Unit 3**
**Nov. 17. – 21.**  
**Object - oriented Programming with Java**

**Content**  
The design and usage of subroutines will be addressed in unit 3.

**Homework**  
Write a program with subroutines.

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**Unit 4**
**Nov. 24. – 28.**  
**Object - oriented Programming with Java**

**Content**  
Unit 4 will cover some advanced programming principles and programming in a bigger context.

**Homework**  
Write a complex java program requiring all contents of the previous units.

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**Unit 5**
**Dec. 01. – 05.**  
**Application of MATLAB**

**Content**  
The basic features of MATLAB will be addressed in Unit 5 including the components of the MATLAB desktop, working with M-files, precedence, arithmetic and the generation and manipulation of arrays and matrices.
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### Homework:
Questions and simple programming exercises requiring knowledge of the contents of unit 5

### Unit 6
**Dec. 08. – 12.**
**Application of MATLAB**

**Content**
Unit 6 will primarily be focused on relational and logical operators and flow control. IF- and SWITCH-statements and different types of loops will be addressed as well as some advanced programming features like function handles, sub-functions and nested functions.

**Homework**
Questions and advanced programming exercises requiring knowledge of the contents of units 5 -- 6

### Unit 7
**Dec. 15. – 19.**
**Application of MATLAB**

**Content**
Unit 7 will cover MATLAB's graphics capabilities. Different plot types for two- and three-dimensional graphics and the customization of the figures will be addressed.

**Homework**
Programming exercises requiring knowledge of the contents of units 5 -- 7

### Unit 8
**Jan. 12. – 16.**
**Application of MATLAB**

**Content**
Unit 8 will address further advanced programming features like structures and cell arrays, MATLAB's sparsity features and file input / output.

**Homework**
Questions and advanced programming exercises requiring knowledge of the contents of units 5 -- 8

### Unit 9
**Jan. 19. – 23.**
**Application of MATLAB finite element software**

**Content**
The first unit will cover the requirements for using the Finite Element Program. In a live lecture, the finite element program will be explained in detail. The program sequence, as well as the sub-functions of the program will be elucidated. In the first Content, 1D Problems will be examined.
Homework  Create the sample routine for a given structure and evaluate the results.

### Unit 10
**Jan. 26 – 30.**  Application of MATLAB finite element software

**Content**  In the second content, truss elements in 3D will be examined.

**Homework**  Create the sample routine for a given 3D wind turbine truss-structure and evaluate the static results.

### Unit 11
**Feb. 02. – 06.**  Application of MATLAB finite element software

**Content**  In the third content, dynamic studies are examined for truss elements.

**Homework**  Create the sample routine for a given 3D wind turbine truss-structure and evaluate the dynamic results.

### Unit 12
**Feb. 09. – 13.**  Application of MATLAB finite element software

**Content**  In the fourth content, static studies are performed using 2D elements.

**Homework**  Create the sample routine for a given 2D wind turbine structure and compare the results with the Homework of unit 10.

### Unit 13
**Feb. 16. – 20.**  Application of OpenFoam

**Lecture:** Application of Open Foam  The first unit gives a brief introduction in computational fluid dynamics (CFD). The basics of using the software tool OpenFoam are explained. A compiled version of the tool is provided.

**Homework**  Understanding of using CFD software, installation and integration of the software, start of the program, first introduction.
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### Unit 14
**Feb. 23. – 27.**

**Application of OpenFoam**

**Homework:** Application of OpenFoam

Execute the given tutorial of a cavity lid driven fluid flow: meshing, compute the velocity and pressure field, change of boundary and operation conditions, visualization of the results.

### Unit 15
**Mar 02. – 06.**

**Application of OpenFoam**

**Homework:** Application of OpenFoam

Understanding of the homework assignment, meshing the new geometry, simulation of the fluid flow, calculation of forces on the geometry.

### Unit 16
**Mar. 09. – 13.**

**Application of OpenFoam**

**Homework:** Application of OpenFoam

Writing a technical report of the homework assignment. This report is the basis of the grading.