

## **Course: Numerical Methods**

**Teaching hours:** 30h (15 lectures, 15 laboratory)

**Prerequisites:** The course is primarily open to all PhD students at Gdansk University of Technology. This course is compulsory for PhD students assigned to Civil Engineering and Transport as well as Environmental Engineering, Mining and Power Engineering tracks at Doctoral School of GUT.

### **Course outline**

#### **Content**

The course ensures complete knowledge of usage of one of the most popular compilers in engineering. The participants have the possibility to use interpreters (e.g. Matlab). Meanwhile, commercial software devoted to the finite element method provides wide opportunity to create own subroutines and functions. These subroutines should be usually created in Fortran (Abacus, MSC.Marc, MSC.Adams). The advanced knowledge of this compiler is required. Knowing the idea of interpreter, the participants can easily apply their experience into compiler. Nevertheless, some important rules should be explained and obeyed. Full course of Fortran makes it possible. During lectures, the participants will use computers to implement the presented commands in their programs. The interaction between the participants and the teacher is required. Some small programs created during the course can be used by participants in their research.

#### **General topics coverage:**

1. Fortran as the basis of creation of own routines in commercial software devoted to the finite element method. Environment of Fortran compiler, compilation linking and running a program. Debugging.
2. Basic elements of Fortran 77
3. Basic commands
4. Input/output statements. Formatting
5. Procedures and functions.
6. Program structure
7. Differences between Fortran 77 and Fortran 90/95

#### **Teaching mode**

The lectures will be mixed with laboratories. During the presentations, the basic knowledge of Fortran language will be given. At the same time, programs will be created by each participant on his/her own computer. In these programs, the chosen elements will be presented in different variants.

#### **Examination**

At the beginning of the course, students will receive the subjects of their final project. The projects will be related to specific engineering problems or can be proposed by participants according to their current research. After the course, each participant should create his/her own Fortran program, prepare the instruction to it, ensure correctness of the program and be able to discuss the way of solution. Oral presentation in front of the teacher will be the foundation of the course finalization.

#### **Fundamental readings:**

1. [https://web.stanford.edu/class/me200c/tutorial\\_77/](https://web.stanford.edu/class/me200c/tutorial_77/)

2. [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwjSkrrmud\\_mAhVpkIsKHXLdBzAQFjACegQIBBAE&url=http%3A%2F%2Fphysik.uibk.ac.at%2Fhephy%2Fpraktikum%2Ffortran\\_manual.pdf&usg=AOvVaw2xTTwHEMQ9PrVTR\\_M-YnSm](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=2ahUKEwjSkrrmud_mAhVpkIsKHXLdBzAQFjACegQIBBAE&url=http%3A%2F%2Fphysik.uibk.ac.at%2Fhephy%2Fpraktikum%2Ffortran_manual.pdf&usg=AOvVaw2xTTwHEMQ9PrVTR_M-YnSm)
3. [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=2ahUKEwjSkrrmud\\_mAhVpkIsKHXLdBzAQFjAEegQIARAE&url=https%3A%2F%2Fwww.iopb.res.in%2Ffortran.pdf&usg=AOvVaw1zklewOMdHIQBHtPXM6o1d](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=5&cad=rja&uact=8&ved=2ahUKEwjSkrrmud_mAhVpkIsKHXLdBzAQFjAEegQIARAE&url=https%3A%2F%2Fwww.iopb.res.in%2Ffortran.pdf&usg=AOvVaw1zklewOMdHIQBHtPXM6o1d)
4. [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=2ahUKEwi04Lukut\\_mAhXLpIsKHVOABjsQFjACegQIBxAJ&url=https%3A%2F%2Fwww.u-cergy.fr%2F\\_attachments%2Fadvanced-monte-carlo-methods-article%2Fdurham\\_fortran90.pdf%3Fdownload%3Dtrue&usg=AOvVaw2Yptyaq4bCK6RbdVZU9uZV](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=2ahUKEwi04Lukut_mAhXLpIsKHVOABjsQFjACegQIBxAJ&url=https%3A%2F%2Fwww.u-cergy.fr%2F_attachments%2Fadvanced-monte-carlo-methods-article%2Fdurham_fortran90.pdf%3Fdownload%3Dtrue&usg=AOvVaw2Yptyaq4bCK6RbdVZU9uZV)