

Subject Guide – Computer-Aided Engineering Tools 1

Shortened Name	CAET1	Semester	1-2025
Class Time (weekly)	Fri, 13-16	Lecture hours	3h x 15w
Subject Code	090125102	Assignment and self-study	5h x 15w
ECTS credits	6	Preparation for exam	30
KMUTNB Credits	3(3-0-6)	Total working hours/semester	150

1 Revision date of this document, reasons for revision

- 30.07.2025

2 Course description

A series of self-contained modules to give students the necessary knowledge and practical skills needed for the application of computers and engineering software on engineering problems, specifically in the fields of

- Parametric 3D Computer-Aided Design (CAD),
- Structural Analysis by FEM,
- programming of C/C++ code for specific simulation purposes,
- programming of Python code for specific simulation purposes, and
- Machine Learning.

The class enables the students to apply the covered tools in other courses as well as research and thesis work and prepares industrial application. At least an introductory standard is established that enables the students to continue to develop their skills by further self-study or self-guided tutorials. The covered software includes commercial and non-commercial products and is constantly revised to keep up with current developments and to balance the requirements of industrial application and academic research.

3 Lecturers

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| • 3D-CAD (PTC Creo Parametric) | Dr. Alex Brezing (course coordinator) |
| • FEM fundamentals (ABAQUS) | Mr. Itsara Rojana,
Ms. Kamonchanok Hirunwat |
| • C/C++ programming & numerical methods: | Dr. Ekkapot Charoenwanit |
| • Python programming and machine learning: | Dr. Chinnawut Nantabut |

4 Assessment

Each student will be individually assessed based on the performance on assignments and a written exam, with the overall grade resulting from the shares as below:

	Assignments	Exam
3D-CAD - PTC Creo Parametric	(2 * 5%=) 10%	36/180 points
FEM - ABAQUS	(2 * 5%=) 10%	24/180 points
C/C++ Programming	(4 * 5%=) 20%	60/180 points
Python Programming and Machine Learning	(4 * 5%=) 20%	60/180 points
Total share	60%	40%

- Assignments will be given as homework during most classes (see below). All assignments are due at the beginning of the next class, submitted by email to the lecturer who held the class. Late submission results in 20% deduction per week.
- Additionally, for the C/C++ and Python parts, 50% of the assignment grade will be based on the submitted code, while the remaining 50% will be assessed through an in-class assignment discussion during the last teaching week.
- Comprehensive exam, closed book, mostly written/per-based; CAD-part possibly partly done on students' own laptop. 180 minutes.

5 Teaching materials

- Lecture slides and assignments are shared as electronic files.

6 Books and references

- Starting out with C++ Early Objects, 8th Ed., by Tony Gaddis, Judy Walters, and Godfrey Muganda. Pearson Education & Addison-Wesley
- Numerical Methods for Engineers, 6th Ed., by Steven C. Chapra and Raymond P. Caddle. McGraw-Hill.
- Pattern Recognition and Machine Learning Book by Christopher Bishop.
- Deep Learning by Aaron Courville, Ian Goodfellow, and Yoshua Bengio.
- Python Tutorial Release 3.7.0 by Guido van Rossum and the Python development team.
- Hands-on Machine Learning with Scikit-Learn, Keras, and TensorFlow by Aurélien Géron.
- Deep Learning with PyTorch by Eli Stevens, Luca Antiga, and Thomas Viehmann.

7 Course schedule

Week	Date (2025)	Activity, Class Title (unit number)	Evaluation %	Class Hours
1	08/08	CAD Software Installation and Settings Configuration (0)	-	-
2	15/08	CAD/CREO: Part Modelling and Drafting Strategies; Standard Geometries (1)		3
3	22/08	CAD/CREO: Assembly Modelling Strategies (2)	5%	3
4	29/08	CAD/CREO: Part Modelling Strategy: Advanced Geometries (3)	5%	3
5	05/09	FEM/ABAQUS: 2- and 3-Dimensional Elements (4)	5%	3
6	12/09	FEM/ABAQUS: FEM with Imported Geometry (5)	5%	3
7	19/09	C/C++: Variables, Basic Programming Constructs, IO (6)		3
8	26/09	C/C++: Pointers, Functions, Parameter Passing Techniques (7)	5%	3
9	03/10	C/C++: Memory Management (8) (no Midterm Exam but class)	5%	3
10	10/10	C/C++: Structures and Classes (9)	5%	3
11	17/10	C/C++: Compilation & Linking Process (10)	5%	3
12	24/10	Python/ML: Introduction to Python and Packages (11)	5%	3
13	31/10	Python/ML: Introduction to Machine Learning and Scikit-learn (12)	5%	3
14	07/11	Python/ML: Introduction to Deep Learning (13)	5%	3
15	14/11	Python/ML: Introduction to PyTorch (14)	5%	3
16	21/11	C/C++ & Python/ML: Assignment Discussion (15)		3
17	28/11	FINAL EXAM	40%	
18	05/12	FINAL EXAM (optional)		
(Sums)			100%	45

8 Content details

Unit #	Title	Lesson (L) Contents
1	CAD/CREO: Part Modelling and Drafting Strategies; Standard Geometries	- Methodology of sketching and dimensioning - Modelling strategy for machined parts and lathed parts - Drafting strategy and features
2	CAD/CREO: Assembly Modelling Strategies	- Overview of Industrial Engineering Design Process - CAD-modelling strategy: Top-Down/Bottom-Up - Assembly modelling with skeleton models
3	CAD/CREO: Part Modelling Strategy: Advanced Geometries	- Fully parametric geometry vs. freeform geometry - Modelling strategies for cast parts - Features for modelling cast geometry
4	FEM/ABAQUS: 2- and 3-Dimensional Elements	- Modelling and manual meshing of simple geometries - Definition of 2-D and 3-D elements - Linear-elastic static loadcase with sandwich material
5	FEM/ABAQUS: FEM with Imported Geometry	- Importing complex geometry - Automatic, semi-automatic and manual meshing - Linear-elastic static loadcase with heat transfer
6	C/C++: Variables, Basic Programming Constructs, IO	- Variables and type system - Basic programming constructs - Basic IO operations
7	C/C++: Pointers, Functions, Parameter Passing Techniques	- Pointers and pointer arithmetic - Function calls - Parameter passing techniques
8	C/C++: Memory Management	- Storage duration - Memory allocation/dellocation - Dangling pointers & memory leaks
9	C/C++: Structures and Classes	- User-defined data types - Object-oriented programming - Operator overloading
10	C/C++: Compilation & Linking Process	- Preprocessing - Compilation - Linking
11	Python/ML: Introduction to Python and Packages	- Variables, control flow, and data structures - Modules and classes - Essential packages
12	Python/ML: Introduction to Machine Learning and Scikit-learn	- End-to-end machine learning projects - Unsupervised learning - Supervised learning
13	Python/ML: Introduction to Deep Learning	(Deep) neural networks - Optimization in neural networks - Convolutional neural networks
14	Python/ML: Introduction to PyTorch	- Introduction to tensors - Defining (convolutional) neural networks - Training and testing (convolutional) neural networks
15	C/C++ & Python/ML: Assignment Discussion	- Present and explain one's own code - Implement code based on a given task - Translate code between C/C++ and Python