Subject Guide – Computational Fluid Dynamics

Shortened Name	CFD	**Semester**	2-2023
Class Time (weekly)	Fri, 9-12	**Lecture hours**	3h x 15w
Subject Code	090125208	**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

- 03.01.2023

2 Course description

Governing Equations of Fluid Dynamics; Classification and Characteristic Lines of Partial Differential Equations; Foundations of Numerical Solution; Iteration Schemes for Elliptic Differential Equations; Numerical Solution of Parabolic Differential Equations; Numerical Solution of Hyperbolic Differential Equations; Finite Volume Method; SIMPLE Algorithm; Rhie-Chow Interpolation. The course will include workshops on writing three basic CFD codes and developing an in-house CFD code for solving engineering problems.

3 Lecturer/Teaching Assistant

- Assoc. Prof. Dr. Ekachai Juntasaro
- Dr. Ekkapot Charoenwanit
- Mr.Nattawood Prasartthong (Research Assistant)

4 Expected learning outcomes (in accordance with the MAE program ELOs)

Primary LOs (primary content of class, knowledge is explicitely evaluated (for example, by exams), larger share of overall grade)

- Ability to define a technical task or problem, to analyze/structure it and formulate a strategy to solve it (GELO 1)
- Knowledge and understanding of methodology of simulation and design (SELO 1)

Secondary LOs (not primary content of class, but implicitly taught by application (for example, by project work or assignments) and evaluated, lower share of overall grade)

- Report writing skills (GELO 3)

Note: These ELOs correspond to the MAE program ELOs (referenced in parantheses).

5 Assessment

Each student will be individually assessed based on the performance on CFD code coursework and paper exam, with the overall grade resulting from the shares as below:

Evaluated items	**shares**
Basic CFD code coursework, 9 hours, on content of "**Sessions 5, 7, 9**" of the class	30%
Paper exam, 3 hours, on content of "**Sessions 10, 11, 12**" of the class	40%
In-house CFD code coursework, 9 hours, on content of "**Sessions 14, 15, 16**" of the class	30%
Total	**100%**

6 Teaching materials

- Power-point presentations for lectures, handed over as reference and learning material
- E-books are provided by email before the first day of the class

7 Books and references

1) Main Textbook: *Computational Fluid Dynamics I + II* by Prof. Dr.-Ing. D. Hanel, Institute of Aerodynamics, RWTH Aachen University.
2) Main Textbook: *Numerical Methods for Engineers and Scientists* by Joe D. Hoffman (Latest Edition), Marcel Dekker.
3) Main Textbook: *An Introduction to Computational Fluid Dynamics: The Finite Volume Method* by H. K. Versteeg and W. Malalasekera (Latest Edition), Prentice Hall.
4) Supplementary Textbook: *Computational Fluid Mechanics and Heat Transfer* by John C. Tannehill, Dale A. Anderson and Richard H. Pletcher (Second Edition), Taylor&Francis.

The book of item 4 is not required to take part in the course but recommended as background reading.

8 Course schedule

Week	Date/Month	Activity, Class Title (Book Chapter)	Evaluation %	Class Hours
1	05/01	Course Introduction & Governing Equations of Fluid Dynamics		3
2	12/01	Classification and Characteristic Lines of Partial Differential Equations		3
3	19/01	Foundations of Numerical Solution		3
4	26/01	Iteration Schemes for Elliptic Differential Equations		3
5	02/02	**Workshop on writing a basic CFD code: Elliptic solver**	10%	3
6	09/02	Numerical Solution of Parabolic Differential Equations		3
7	21/02	**Workshop on writing a basic CFD code: Parabolic solver**	10%	3
8	01/03	Numerical Solution of Hyperbolic Differential Equations		3
9	08/03	**Workshop on writing a basic CFD code: Hyperbolic solver**	10%	3
10	15/03	Finite Volume Method		3
11	22/03	SIMPLE Algorithm		3
12	29/03	Rhie-Chow Interpolation		3
13	05/04	**Paper exam**	40%	3
14	12/04	**Workshop on developing an in-house CFD code for solving engineering problems I**	10%	3
15	19/04	**Workshop on developing an in-house CFD code for solving engineering problems II**	10%	3
16	26/04	**Workshop on developing an in-house CFD code for solving engineering problems III**	10%	3
		Sum	100%	48

9 Details on the evaluation of Expected Learning Outcomes

		Basic CFD codes	Paper exam	In-house CFD code	Total
		30%	40%	30%	
GELO1	Ability to define a design task or problem, to analyze/structure it and formulate a strategy to solve it	10%	20%	10%	**40%**
SELO1	Knowledge and understanding of methodology of simulation and design	10%	20%	10%	**40%**
GELO3	Report writing skills	10%	-	10%	**20%**