1. Subject name	**Numerical Methods for Fluid Flows I.**				
2. Subject name in Hungarian	Numerikus módszerek az áramlástanban I.				
3. Code	**BMEKORHD006**	4. Evaluation type	**exam grade**	5. Credits	**2**
6. Weekly contact hours	**2 (0) Lecture**	**0 (0) Practice**	**0 (0) Lab**		
7. Curriculum	**PhD Programme**	8. Role	**Specific course**		
9. Working hours for fulfilling the requirements of the subject					**28**
Contact hours	28	Preparation for seminars	0	Homework	0
Reading written materials	0	Midterm preparation	0	Exam preparation	0
10. Department	**Department of Aeronautics and Naval Architectures**				
11. Responsible lecturer	Dr. Veress Árpád				
12. Lecturers	Dr. Veress Árpád				
13. Prerequisites					

14. Description of lectures

Introduction to numerical methods for fluid flows, Mathematical models of flow physics and approaches for considering the dynamic level of approximations, Mathematical nature of flow equations and their boundary conditions, Basic discretization techniques (finite difference, finite volume and finite element methods), Numerical meshes and their properties, Numerical schemes their characteristics and investigation methods (consistency, stability and convergence), High resolution numerical schemes, Time integration methods for space-discretized equations, Iterative methods for the resolution of algebraic systems, Applications for inviscid and viscous flow. (book by Hirsch I.)

15. Description of practices

16. Description of labortory practices

17. Learning outcomes

A. Knowledge
- The student knows the governing equations of the numerical methods for fluid flows, the most widespread discretization methods, their characteristics, the relevant numerical schemes and algorithms and their mathematical analysis in the state of the art manner.

B. Skills
- The student can perform and/or develop numerical discretization of the governing equations according to the requirements and the mathematical analysis of numerical schemes and algorithms resulted by the numerical discretization.

C. Attitudes
- The student aims to complete his/her studies at the highest level, under the shortest time, by providing his/her knowledge and capacity at the best to obtain knowledge for deep and independent professional work.
- The student has strong professional commitment, has developed expectations for finding new, better solutions and has agreement on doing hard work.

D. Autonomy and Responsibility
- The student takes responsibility for guiding mates by the quality of his/her work and by keeping ethic norms.
- The student takes responsibility for applying the knowledge in line with the studied conditions, limitations and constraints.
- The student can friendly accept the well-established constructive criticism and can utilize that in future.
- The student is a creative constructor, proactive, and has leadership skills and argument techniques, capabilities with responsibility during the studies, research work.

18. Requirements, way to determine a grade (obtain a signature)

The criterion of the acceptance of the semester and so getting the signature is the completeness of the solution of a defined problem in a specific area in the agreed time and quality. The exam is oral. The final mark of the exam is the mathematical average of the results for the own task and the exam.

19. Opportunity for repeat/retake and delayed completion

20. Learning materials

1. The presentation about the lectures, simulation guide lines and tutorials provided by the professor,
2. Hirsch, Charles: Numerical Computation of Internal and External Flows, Volume 1 and 2, ISBN-10: 0471923850, ISBN-13: 978-0471923855, John Wiley and Sons (2001), 3. Veress, Á.: Introduction to CFD, BME, Department of Aeronautics, Naval Architecture and Railway Vehicles, Lecture notes, (2002), 4. ANSYS, Inc., ANSYS CFX-Solver Theory Guide, Release 2019 R1, ANSYS, Inc. Southpointe, 2600 ANSYS Derive Canonsburg, PA15317, ansysinfo@ansys.com, http://www.ansys.com, USA, 2019.

Effective date	27 November 2019	**This Subject Datasheet is valid for**	Inactive courses