Final exam questions

Subject group name: **Computational Fluid Dynamics**

Neptun code: ZVEGEÁTNW02

Credit points: 5

Subject in this subject group:

- **Computational Fluid Dynamics** (BMEGEÁTNW02)

Program: Mechanical Engineering Modelling, MSc (2N-MW0)

Specialization: Fluid Mechanics

Responsible person:

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You can check the current subject forms at the Educational Portal of the Faculty of Mechanical Engineering.

https://oktatas.gpk.bme.hu/

Always check the for updates at edu.gpk.bme.hu before preparing for the exam, especially if the subject group contains at least one subject from your final semester!

Valid from 01 September 2021

Dr. Gergely Kristóf

associate professor

1. Please demonstrate the application of the finite volume method by discretizing the one-dimensional energy equation! What do we mean by the conservative character of the finite volume method? Apply the central differencing scheme for discretizing the fluxes!

2. What do we mean by the transportivity of the flux schemes? Please, demonstrate the application of the first-order upwinding scheme in a one-dimensional example! Calculate the artificial diffusivity introduced by the upwinding scheme!

3. Please describe the segregated iteration technique applied for solving the governing equations of the psi-omega method!

4. Please derive the Poisson equation for the pressure (pressure equation) from the Navier-Stokes equation! Please explain how the numerical errors are accumulated in the continuity equation when the pressure equation is solved in its original form! Describe the projection method!

5. Please explain the SIMPLE algorithm for steady-state flows!

6. Please show the algebraic system of equations obtained by the discretization of the 2D Poisson equation! Explain the iterative solution methods of linear systems in general and then show the Gauss-Seidel relaxation scheme as an application of this methodology!

7. Please explain the multigrid method applied for the 1D form of the Poisson equation!

8. Derive Riemann-invariants of governing equations of 1D time-dependent isentropic gas flow and explain the method of characteristics! What are the technical problems with the practical application of this method?

9. Please formulate the governing equations of 1D isentropic gas flow in the conservative form! Demonstrate the application of the two-step, second-order Lax-Wendroff method!

10. Please describe the following multiphase flow models and give some application examples: 1) Volume of Fluid, 2) Mixture, 3) Eulerian and 4) Lagrangian.