# Final exam questions

Subject group name: **Fluid Flow Technology**

Neptun code: ZVEGEVGBG13

Credit points: 7

Subject(s) in this subject group:

- **Fluid Flow Systems** (BMEGEVGBG13)
- **Positive Displacement Pumps and Compressors** (BMEGEVGBG16)

Program: Mechanical Engineering, BSc (2NAAG0)

Specialization: Process Engineering

Responsible person(s):


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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 27 February 2023**

*Dr. Péter Csizmadia*

*associate professor*

*Dr. Csaba Hős*

*associate professor*

**Fluid Flow Systems (BMEGEVGBG13)**

I. Water distribution networks
   1. Explain the basic principles of steady-state flow system analysis!
   2. Introduce the main assumption and equations of water distribution networks!
   3. Explain the modelling of the headloss, explain the modelling of minor losses!
   4. Explain the basic nature of the characteristic curve of pipelines with incompressible fluids!
   5. Explain the basic nature of the characteristic curve of pumps!
   6. Introduce the parallel and series connection of systems and pumps!
   7. Explain how to calculate the operation point of a water distribution system graphically!
   8. Introduce the main equations of a water distribution system, use a simple example!
   9. Explain the Netwon's technique in one dimension, and in general!
   10. Introduce how can the Netwon's technique be applied for water distribution systems, explain the main parts of the Jacobian matrix!

II. Compressible fluids
   1. Define the basic equations of a compressible fluid system for edges and nodes!
   2. Derive the equation of pressure loss for isothermal system with compressible fluid!
   3. Derive the formula between temperature and Mach number for compressible, adiabatic fluids!
   4. Explain how to calculate the field variables at the end of a pipeline for compressible, adiabatic fluids!

III. Open-channel flows
   1. Derive the ODE describing the water level y(x) for open-channel steady state flows!
   2. Introduce the area, the width, the wetted perimeter and the hydraulic radius of the rectangular and trapezoidal cross-sections in open-channel flows!
   3. Introduce the Froude-number! How does it characterize the flow?
   4. Derive the specific depths for open-channel flows! Represent graphically some specific flows!
   5. Introduce a numerical technique for solving the ODE describing the water level y(x) for open-channel flows!
   6. Derive the equation for a hydraulic jump describing the height difference in open-channel flows!

**Positive Displacement Pumps and Compressores (BMEGEVGBG16)**

1. Explain the basic difference between positive displacement machines and turbomachines (operating principle, concept of displacement, pressure -force / torque, flow rate /velocity relationship with derivation for pumps and motors)

2. Reciprocating pumps: Flow rate (mean, max) for single acting, double acting and triple acting. How does the pressure pulsation change with the number of pistons?

3. Cavitation of reciprocal pumps.

4. Piston compressors. Explain the concept of effective flow rate with the help of p-V diagram. Multistage compressors: why is it advantageous to split the compression in to two or more stage (use the p-V diagram). Optimal pressure ratio.

5. Pressure vessel sizing: Main assumption and steps (pulsation dampers)

6. Given a PDP, a pressure relief valve and a motor, explain the concepts of setting a desired operating point. Evaluate the difference concepts from the viewpoint power losses.