Final exam questions

Subject group name: **Fluid Mechanics elective – Vehicle Aerodynamics**

Neptun code: ZVEGEÁTNW19

Credit points: 3

Subject in this subject group:

- **Vehicle Aerodynamics** (BMEGEÁTNW19)

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

Specialization: Fluid Mechanics

Responsible person:

- Dr. Jenő Miklós Suda, suda.jeno.miklos@gpk.bme.hu
  Department of Fluid Mechanics, Faculty of Mechanical Engineering

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. Jenő Miklós Suda

assistant professor

1. Describe the aerodynamic characteristics of the flow around streamlined and bluff bodies and sketch flow streamlines. Derive the formula for the aerodynamic force acting on a body immersed in a viscous fluid flow. Explain the derivation steps: how the reference parameters and the non-dimensional coefficients are included in the final form.
2. Explain and sketch the main characteristics of the pressure distribution on a sharp-edged prismatic bluff body. (Incident flow direction is parallel to the longitudinal symmetry axis.) Explain the influence of the rounding-up and ground proximity. List the methods of reducing front drag.
3. Four main periods: Describe the four main periods in the history of vehicle aerodynamic developments. Describe with examples (vehicles & designers) the main characteristics (advantages & drawbacks) of all four periods.
4. Optimum slenderness ratio. Describe the effects of boat-tailing (tapering of the cross-section at the rear part of the body) in the case of a passenger car. Describe the effects of the slanted rear wall on the lift and drag forces, and show the changes in the flow field and in drag as a function of the slanting angle.
5. Describe the formation of the lift force acting on a vehicle body. Show methods for creating downforce both for passenger and race cars. Explain the methods for increasing aerodynamic efficiency of the front and rear wings and the underbody flow.
6. Sketch and explain the typical pressure distribution on the vehicle body along the vertical and horizontal mid-centre body contour. Describe the influence of the side wind on the pressure distribution - consequences on the aerodynamics forces, moments and driving characteristics.
7. Aerodynamic analysis of front and rear spoilers/wings. Methods for aerodynamic performance improvement (influence of end-plates, side fins, Gurney-flap, shear layer conditioning etc.).
8. Aerodynamic characteristics of the flow around wheels (steady/rotating; free-standing/in wheelhouse). Methods for wheel drag reduction: influence of front spoiler height/width, wheel width, air deflectors, brake cooling air vents, rim design etc.
9. Drag area vs aerodynamic power loss. Explain the advantages/disadvantages of roof camber and side camber. Possibilities for decreasing drag area. Influence of attachments.
10. The ratio of aerodynamic and rolling drag for various types of ground vehicles. Influence of the relative change in drag on the relative change in fuel consumption. Aerodynamic data statistics for various types of ground vehicles.
11. Blockage correction and simulation methods for moving ground in wind tunnel testing. Consequences of ground proximity and the closed test section.
12. Key questions of the vehicle aerodynamics: active aerodynamic elements, body sculpturing, flexible body surface, problematics of the side mirrors and rotating wheels in the wheelhouse with/without side coverings, further possibilities of drag reduction in the case of new concept cars.