Aerodynamics and Its Applications for Vehicles

BMEGEÁTMW09

MID-TERM EXAM QUESTIONS

1. Derive the equation for the force acting on a body that is placed in a fluid flow (with and without friction). What are the two dimensionless coefficients that appear in the equation and what is their order of magnitude?
2. Define streamlined and bluff bodies. Sketch the flow field around them. What is the physical quantity that dominates in the drag force acting on these bodies?
3. What is boundary layer separation and what are the conditions so that is happens (sketch)? List some methods to favour and to inhibit or postpone boundary layer separation.
4. List the characteristics of a passive/2D separation bubble with the help of a sketch. What does the pressure inside the bubble depends on and how?
5. How does and active separation bubble form? What are its characteristics?
6. Describe the formation of the drag force on a prismatic body with sharp edges. Sketch the flow field around it. Estimate the magnitude of each component of the drag force (front face, sides, rear face).
7. Describe the formation of the drag force on a prismatic body with rounded edges. Sketch the flow field around it. Estimate the magnitude of each component of the drag force (front face, sides, rear face). How does the rounding up of the leading edges reduce the drag force?
8. List (with help of sketches) some alternative methods to reduce the drag force forming on the front face of a prismatic body (other than rounding up the leading edges.)
9. What were the four periods of car development and what are the basic characteristics of each of them?
10. Describe the formation of the lift force around a passenger car and its effects. List three methods to decrease the lift force acting on the car.
11. Define tapering of the rear of a car. How does of is effect the drag coefficient? Explain its mechanism with the help of a sketch.
12. Describe the flow field forming at the rear of a fastback car, and show the lift force acting on it in function of the angle relative to the horizontal of the rear windshield.
13. How do wheels and wheel housings affect the drag and lift coefficient acting on a car? Explain the mechanism with the help of a sketch of the pressure distribution around the wheel.
14. With the help of a sketch show the working mechanism of the front and rear spoilers placed on a passenger car. How do they affect the drag and lift coefficients?
15. How do the front spoiler and the rounding up of the top leading edge of a passenger car interact? How does this interaction influence the drag force?
16. List – without explanation - at least eight methods to reduce the drag force acting on a passenger car.
17. Show with the help of a sketch how the side wind changes the pressure distribution and therefore the turning moment acting on a passenger car. With what methods can the directional stability be increased in windy circumstances?

18. Describe the functioning of a diffuser in case of race cars. What parameters should be taken care of? What is the disadvantage of a diffuser and how can it be moderated?
19. Explain how slats and flaps can increase the efficiency of a wing? Sketch a diagram of the lift coefficient in function if the angle and show the effect of slats and flaps as well.
20. Explain what aspect should be considered when installing a rear wing on a race car (distance from rear wheels, wing profile, end-plate).
21. Define ground clearance, and show how it affects the lift coefficient of a race car.
22. Sketch an open circuit wind-tunnel. Explain the function of each element.
23. Considering wind tunnels: what are the advantages and disadvantages of an open and closed test-section? Define blockage ratio and how it affects the flow field around a body.
24. Write down at least six methods for soil modelling in a wind tunnel. Describe the advantages and disadvantages of each briefly.