

## **TOPICS for the STATE EXAM from the course titled „Core Elements of Whole Vehicle Development”**

**15 January 2020**

### **General philosophy of questions:**

1. The Examiner aims to check,
  - a. whether the student has a good engineering thinking in the given topic
  - b. whether he/she can have a good discussion about the given topic in a dialogue format
  - c. whether he has clues about the key figures (for example: typical values for drag, typical hot-spot temperatures, etc.) in the area of vehicle development
2. The student draws a certain topic from the list below, in which area 3-5 questions will be asked by the Examiner
3. The Examiner's questions will be provided in „layers”, with:
  - a. top layer (first question): easiest, foundation-knowledge based question
  - b. bottom layer (last question): hardest, detailed understanding based question
4. Preparation for the questions:
  - a. The top level question will be given to the student in writing and the student will be asked to work it out in the preparation time.
  - b. The deeper level questions *might be* listed in writing, or *can be* asked by the Examiner on the spot, i.e. as a response to the top level question's answer from the student.
5. The student will be evaluated on the basis on how deep he/she could go in the layers with successfully answering the questions.
  - a. Answering all layers successfully: outstanding result
  - b. Answering only the top layer question correctly (and not being able to answer any other questions): minimum expectation to get a passing grade
  - c. Not being able to answer even the top layer question: fail

## Topics of top layer questions:

*Note: a combination of related topics can also be given by the Examiner*

- General:
  - o Roles of Whole Vehicle Development within Technical Development
  - o Virtual vehicle development – current status and future trends
- Vehicle Properties:
  - o Development process
  - o V-diagram
  - o Vehicle properties
  - o Stakeholders
  - o Basics of Systems Engineering
- Thermomanagement:
  - o physics of external and internal flows,
  - o drag
  - o thermal hot spots
  - o methods for analysing thermomanagement problems
  - o basics of computational simulation methods
- Energy management:
  - o philosophy of energy management analysis of vehicles
  - o major sources of energy losses
  - o stored energy types and their energy density
  - o drivetrain types and their comparative CO<sub>2</sub> emissions, advantages and disadvantages
  - o past and future CO<sub>2</sub> emission standards
  - o methods for analysing energy management problems
  - o challenges of electric vehicles
- Life Cycle Analysis:
  - o LCA terminology and its application in emissions standards
  - o major emission contribution factors by industry sectors and periods of LCA
- Recycling:
  - o Recycling, re-use, recovery terminology
  - o Recycling standards for vehicle manufacturers
  - o Key elements of recycling process
  - o Electric vehicles battery recycling
- Durability and fatigue:
  - o causes of fatigue
  - o load types
  - o analysis types
  - o estimation of cycle numbers
- Acoustics:
  - o Physics of sound generation, propagation and perception
  - o Structure-borne and airborne noise
  - o Evaluation of acoustic results (time-domain, frequency-domain, FFT, Campbell diagrams, transfer functions, sound pressure levels, etc.)
  - o Perception of sound
  - o Basics of computational acoustics analysis methods and their applicability based on frequency
  - o Basics of experimental acoustics methods