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:
  - Roles of Whole Vehicle Development within Technical Development
  - Virtual vehicle development – current status and future trends

- Vehicle Properties:
  - Development process
  - V-diagram
  - Vehicle properties
  - Stakeholders
  - Basics of Systems Engineering

- Thermomanagement:
  - Physics of external and internal flows,
  - Drag
  - Thermal hot spots
  - Methods for analysing thermomanagement problems
  - Basics of computational simulation methods

- Energy management:
  - Philosophy of energy management analysis of vehicles
  - Major sources of energy losses
  - Stored energy types and their energy density
  - Drivetrain types and their comparative CO2 emissions, advantages and disadvantages
  - Past and future CO2 emission standards
  - Methods for analysing energy management problems
  - Challenges of electric vehicles

- Life Cycle Analysis:
  - LCA terminology and its application in emissions standards
  - Major emission contribution factors by industry sectors and periods of LCA

- Recycling:
  - Recycling, re-use, recovery terminology
  - Recycling standards for vehicle manufacturers
  - Key elements of recycling process
  - Electric vehicles battery recycling

- Durability and fatigue:
  - Causes of fatigue
  - Load types
  - Analysis types
  - Estimation of cycle numbers

- Acoustics:
  - Physics of sound generation, propagation and perception
  - Structure-borne and airborne noise
  - Evaluation of acoustic results (time-domain, frequency-domain, FFT, Campbell diagrams, transfer functions, sound pressure levels, etc.)
  - Perception of sound
  - Basics of computational acoustics analysis methods and their applicability based on frequency
  - Basics of experimental acoustics methods