

Please, read the questions properly and do answer only on things that have been asked for! Answers in English, please. No more than two pages per answer. Answer to three of the questions 1 to 6 and both 7 and 8.

1. **What is the so called Vibe-function (Wiebe)?** Why this kind of empirical functions are used? Parameters and variables and the form of the function? Typical values of the main parameters? Are there correlations for variables or parameters for different circumstances: can it be predictive in some cases?
2. **Simulation models: 0-dimensional model vs. 1-dimensional model.** What are the basic equations (only the type of equation or written explanation) of these models in a single control volume? What is the main difference in the mathematical equations, which affect the solution methods? What is the so-called Courant/CFL number and how it is used? What is discretation? What is the typical free variable, i.e. the independent variable, against which the numerical integration is carried out, in 0-d simulation? What is Runge-Kutta 4?
3. **Woschni heat transfer correlation:** What is the basis of the heat transfer coefficient and how Woschni did end up to this form? What was the novel idea of Woschni? What are the main variables or parameters? Is combustion taken into account somehow? Are there any shortcomings?
4. **Computation of valve flow:** what are the variables or parameters affecting the mass flow in valves? (You don't have to know the exact equation by heart.) How the flow equation behaves? Discharge coefficients: how these can be defined (three different ways of reference area)? Draw a sketch of discharge coefficients (σ) with respect to L/D for both intake and exhaust valves.
5. **Turbocharger modeling** and compressor and turbine maps? Make a drawing of maps. How the information of maps is used during simulation runs: what information is given and what we do get out of the maps during simulation? Should the maps be modified somehow for simulation? Where do we need interpolation? What is the turbocharger variable to be integrated during simulation and how does the turbocharger rotor angular speed differential equation look like?
6. What is so called **two zone combustion/cylinder model**? How it is used? Benefits compared to single-zone model? What can you say about heat transfer modelling with two-zone cylinder model? What are the so called **Phenomenological models**? How CI-engine and SI-engine combustion can be modelled without flow field information? Explain in your own words.
7. **Gas dynamics and pressure pulses.** What did you learn during the lectures of DSc Ville Vuorinen? How the things taught are linked to other course contents? No more than one page answer, please!
8. **GT-Power simulation.** What did you learn during the lectures and excersises? How the things taught are linked to other course contents? No more than one page answer, please!