Final exam questions

Subject group name: **Combustion**

Neptun code: ZVEGEENNWCO

Credit points: 5

Subject(s) in this subject group:

- **Combustion** (BMEGEENNWCO)

Program: Modeling MSc (2N-MW0-2019)

Specialization(s): Thermal engineering

Responsible person(s):

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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 01 September 2022

Dr. Viktor JÓZSA

associate professor

1. Please, draw a flow chart of a combustion chamber, indicating the inlet and outlet streams. Describe the gross reactions of hydrocarbon fuels. Define the equivalence ratio.

2. Assuming a steady flame front in a pipe, describe the chemical composition of the gas stream upstream, downstream, and at the flame front. What is the criterion of flame stability? How flame propagation changes when the pressure and/or temperature are altered?

3. Define the adiabatic flame temperature and losses. Why can the adiabatic flame temperature not be reached in reality?

4. Which is the most relevant characteristic droplet size in liquid fuel combustion? Detail the concept of the D^2-law and its connection with the evaporation constant through a single evaporating droplet. What assumptions are necessary to derive the equation of the steady-state evaporation constant?

5. Detail the reactions of the H_2-O_2 system and the explosion limits at 800 K with the dominating set of reactions.

6. Detail the five mechanisms of NO_X formation and their formation conditions (pressure, temperature, equivalence ratio).

7. Classify turbulent flames of gaseous fuels and detail their characteristics. How the jet flame length varies with the fuel jet velocity? Compare the velocity characteristics of laminar and turbulent flames.

8. Present the Borghi diagram and detail the characteristics of the regimes. Where do modern heat engines operate in this diagram?

9. Name the droplet breakup criteria and show the droplet behavior as a function of Weber and Ohnesorge numbers.

10. Show the typical flame shapes for industrial gas and oil burners and detail their characteristics. Define the swirl number.

11. Detail the combustion of a solid fuel particle through the example of coal combustion. How is the combustion of a biomass or waste particle related to this process?

12. Which are the main parts of a valve train for gaseous fuels? What is the role of each piece?