

EEN-E2002 Combustion Technology, 2018

Course Exam April 5, 2018

Problem 1

Describe the SI-engine phenomenon "knocking" (spark knock) briefly, but physically in a correct way. Why this is important in engine combustion? How knocking is detected? Make a graph of cylinder pressure during knocking. How will the engine control unit react when knocking is observed? Why this helps? What operational point (speed, load) is most likely to result in knocking. (6 p)

Problem 2

Explain briefly the four different and existing large engine combustion regimes: Gas Diesel (GD), Dual Fuel (DF), Spark Ignited Gas (SG) and Diesel. Make comments on the fuels for these combustion regimes too. Additional illustrative drawings are preferred. (6 p.)

Problem 3

Consider the combustion of propane gas in an industrial furnace. The properties of propane are given in the accompanying table. Assume a firing rate of 600 kW (based on the lower heating value) and an air factor of 1.1. (6 p.)

Calculate:

- a) Propane flow rate (mol/s).
- b) Combustion air flow rate (mol/s).
- c) Flue gas flow rate (mol/s).
- d) Flue gas composition (mol-%).
- e) Oxygen mole fraction in dry flue gas (mol-%).
- f) Firing rate based on higher heating value (kW).

Propane properties:	Chemical formula	C_3H_8
	Molar mass	44 g/mol
	Lower heating value	2044 kJ/mol
	Higher heating value	2219 kJ/mol

Problem 4

Describe the main steps during the combustion of solid fuels. Explain how the steps are linked to each other and how the events in one step affect the other steps. Describe a specific example of your own choice. Try to illustrate your answer with suitable schematic drawings. (6 p.)