**KE-107.3100 Process Simulation** **-write your name & student no:**
**Examination 30.10.2008; time: 13:00-16:00**

**Theory (max.1h) :** Answer in Finnish, Swedish or English

**1.** Explain shortly:
a) Activity coefficient
b) Dew point
c) Kinetic reactor

**2.** How physical properties are calculated in simulation

**3.** Optimization in process simulation

**Simulation part (2h):** **(Save each task in *prz and *out files and write your answers on paper)**

**1.** Simulate a 10 ideal stage packed tower with 25.4-mm Norton Super Intalox #1 ceramic saddles in atmospheric pressure for absorbing HCl from a gas stream using 20 °C water. The inlet gas flow rate is 56 kg/h $H_2$, 5 kg/h HCl and 4 kg/h $H_2O$ at 30 °C and 101 kPa. The outlet gas must contain 1 mass ppm of HCl.

a) How much water is needed?
b) What is the diameter and packed height of the column?

**2.** Catalytic synthesis of ethyl alcohol produces 1-3 butadiene as the below reaction equation:

$$2C_2H_5OH \rightarrow CH_2=CH-CH=CH_2 + 2H_2O + H_2$$

The stoichiometric feed is at 370 °C and 20 bar in the gas phase. Simulate the equilibrium yield.

**3.** If the ethanol conversion in task-2 reaction is 0.75, simulate the following if two liquid phases is produced:

a) 90% of the hydrogen is separated by flash at 1400 kPa. What is the flash drum temperature?
b) What is the composition of the streams?

**Points: theory:** **2p/each**
**simulation:** **1). 4p, 2). 2p, 3). 4p and exercise attendance 4p.**