**Exercise XX (20%)**

A HV device using normal atmospheric air as an insulating media is intended to be designed to be able to withstand a voltage V = 200 kV without any onset/breakdown activities. The device is intended to be used at 20°C, but with an atmospheric pressure only being 92% of the standard atmospheric pressure (p = 1,01 bar). All edge effects and similar phenomena can be ignored. We want to try to design this device in various ways in this exercise.

Firstly the device is thought to be designed with a field utilization factor η = 1.

a) What should be the gap distance d to fulfill the above conditions?

Secondly the device is intended to be designed as a coaxial cylindrical geometry with a field utilization factor η = 0,50.

b) What should be the radius r of the inner cylinder to fulfill the same conditions?

**Exercise YY (10%)**

Jutland has an approximate area of 30000 km2. Suppose the keraunic level in Jutland is Td = 6 thunderstorm days per year and that stroke current probability curves for the first stroke, negative downward flash follows CIGRÉ.

a) How many lightning with a crest current higher than 50 kA will strike Jutland in one year?

**Exercise ZZ (10%)**

This exercise is regarding transformer differential protection. The exercise can be answered by written explanations.

a) Which things must be taken into consideration when setting the restraint current level for a transformer?

b) How large can be the typical inrush current for a star-delta transformer having a rated power S = 100 MVA. What is causing such inrush current and how does a differential relay avoid tripping?

c) What is sympathetic inrush and why can it be a problem?

d) What is the main problem with transformer winding faults close to the grounded star-point of a star winding? Which type of protection is better for such types of faults?