

By answering the questions in this exam, you assure that you take the exam independently without the help of other people. Potential misconducts will be treated as cheating in the exam.

1. How standards are related to power quality and the management of electromagnetic compatibility in the context of power quality. Give examples of how the standards may be applied in practice and what benefits may be achieved by applying them.
2. What is flicker and what causes it? Why flicker is harmful and how the intensity of flicker may be evaluated? What characteristics of the source of flicker and the network affect the intensity of flicker? Explain the aspects related to the management of flicker from the viewpoint of a distribution system operator (DSO).
3. Explain from the distribution system operators (DSOs) point of view the main goals, needs and functions related to power quality monitoring.
4. Consider a three phase short circuit occurring on one feeder of a radially operated 20 kV distribution network supplied by a 110 kV network. The total resistance and reactance of the supplying 110 kV network and the 110 /20 kV main transformer together, transformed to the 20 kV voltage level, are 1 ohm and 5 ohm, respectively. The feeder resistance is 0.34 ohm/km and the reactance 0.38 ohm/km. The phase-to-phase voltages in the 20 kV network before the fault are 21 kV.
 - a. draw the three phase and single phase equivalent circuits of the fault case
 - b. explain why and how the voltages in the network change due to the fault
 - c. based on calculus, illustrate the dependence of the feeder short circuit current and the substation 20 kV busbar phase-to-phase voltage during the fault on the fault location
 - d. explain shortly how the changes in voltage would be different and have to be calculated differently if the fault was a two-phase short circuit