DEE – 53117 Solar Power Systems

Examination, 28.9.2016

Answer to each question 1, 2, 3 and 4 should fit into one page of a common writing paper.

1.　a)　Tell one concrete measured effect caused by the climatic change during the last 50 years.

　　b)　What is the share of Solar PV power of the total installed electricity production capacity worldwide?

　　c)　What has been the average annual price reduction of PV cells during the past two decades?

　　d)　What has been the average price reduction of PV power systems as a function of their installed cumulative power production capacity?

　　e)　Average daily extra-terrestrial radiation at latitude of 40° is in the middle of summer around 11.5 kWh/m^2 and in the middle of winter about 4 kWh/m^2. What are the corresponding average extra-terrestrial radiations at latitude of -40°?

　　f)　What is the typical maximum lightning current in a strike hitting the earth surface and how high voltage does it cause when hitting an electric transmission line?

2.　a)　What is the charge distribution (qualitatively) inside a silicon solar cell, when it receives a radiation of 0 W/m^2 and a radiation of 1 kW/m^2?

　　b)　Draw the current-voltage curves of a silicon solar cell having an efficiency of 20% and an area of 0.1 m^2, when it receives a radiation of 0 W/m^2 and a radiation of 1 kW/m^2.

　　c)　Three silicon solar cell having an efficiency of 20% and an area of 0.1 m^2 have been connected in series. The first cell receives a radiation of 0 W/m^2, the second one 1 kW/m^2 and the third one 200 W/m^2. Draw the current and the power as a function of voltage applied on the series connection.

3.　Define the following quantities and concepts (mathematically or with one or two sentences).

　　a)　Fill factor.

　　b)　Relative air mass number.

　　c)　Lightning sphere.

4.　a)　How does the open circuit voltage, short circuit current and maximum power of a silicon PV cell depend on the cell temperature? What is the reason for the behaviour?

　　b)　Explain the concept of equipotential bonding. Why, where and how it is applied in practice?