Remember to give feedback in the Kaiku-system to get the final grade. Seppo Valkealahti

You can answer to the questions either in English or in Finnish.

53117 Solar Power Systems

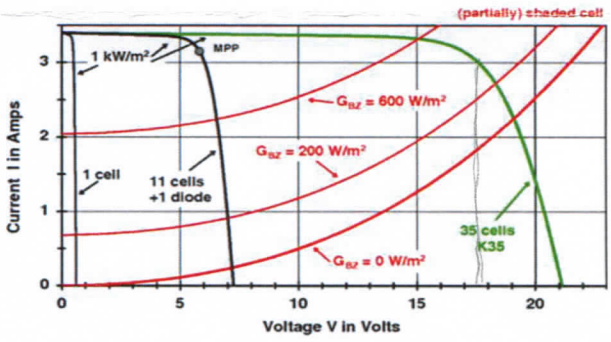
Examination, 5.5.2017

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

1. a) What are the possible maximum power point current and voltage values for a PV string generator (of the order of 20 PV modules connected in series) during partial shading of the generator caused by a building structure (two irradiance levels can take place with varying system shading).
   b) How a typical commercial PV module is built by using silicon photovoltaic cells?
   c) What has been the market share of solar PV power plants in net additions of power generation capacity in EU (European Union) during the past years?

2. a) Extra-terrestrial solar irradiance on the Earth varies annually from 1322 to 1414 W/m^2. How and why does the solar irradiance change on the Earth surface?
   b) What are the electron band structures in existing commercial semiconductor based solar photovoltaics cells (Si and thin film cells)? How is the energy of electromagnetic solar radiation transformed to electrical energy in these PV cells?

3. PV system includes 36 series connected identical silicon PV cells having a short circuit current of 3.4 A in standard test conditions. 18 adjacent cells in the beginning of the series connection are partially shaded obtaining an irradiances of 200 W/m^2 and the rest of the cells are under full irradiance of 1 kW/m^2.



   a) Draw current and power of the series connection as a function of voltage.
   b) Draw current and power of the series connection as a function of voltage, when three bypass diodes are connected in parallel with 12 PV cells each.

4. Imagine that you are selling a PV power system to your customer to be installed on a sloped rooftop of an existing building. The PV modules will function as roof panels (installed parallel to the roof). Your customer asks you about the applicability of the building rooftop for PV power generation, how to make the installation in an optimal way for power production and about possible reasons why a power corresponding to the insolation from the sun might not be received all the time of the day and year. How do you answer to the customer?