Calculator is not need/allowed in the exam.
Remember to give feedback in the Kaiku-system to get the final grade.
You can answer to the questions either in English or in Finnish.

Seppo Valkealahti

DEE-53117 Solar Power Systems

Examination, 16.11.2015

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

1. a) What are the main differences of light absorption in direct and indirect band gap semiconductor materials. How do the differences affect to the light absorption coefficients of these semiconductors?

   b) What are the heat transfer mechanisms affecting to the temperature of a PV module? Write the energy balance equation by which the PV module temperature changes can be calculated under changing operating conditions.

2. Define the following concepts (with one or two sentences).

   a) Air mass.

   b) Depletion region.

   c) Lightning sphere.

   d) Spectral response of solar cell.

3. a) How can a PV cell heat up to create a hot spot in a PV module?

   b) How can PV cells be protected against hot spot heating in a PV module?

4. Three strings of twenty series connected silicon PV cells have short circuit currents of 2.0 A, 4.0 A and 4.0 A.

   a) Draw the current-voltage and power-voltage curves of the PV strings.

   b) Draw the current-voltage and power-voltage curves of a PV system, when the three PV strings are connected in parallel.

   c) Draw the current-voltage and power-voltage curves of a PV system, when the three PV strings are connected in series.

   d) Draw the current-voltage and power-voltage curves of a PV system, when the three PV strings are connected in series and each string is protected with a bypass diode connected in parallel with it.