NTSY1: Natural and Technical Systems

Test 2, November 2015

First Semester WI15

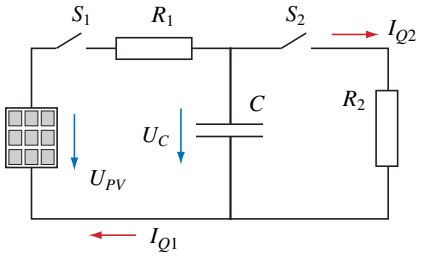
Allowed tools: **Personally writtensummary. Book: The Dynamics of Heat.** Calculators and writing materials.

Answers must be explained and must be documented.

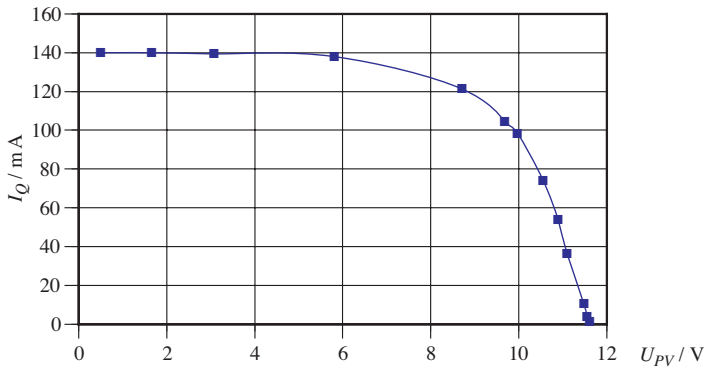
Duration of the exam: 60 minutes.

Electric circuit with PV panel

The diagram below shows a circuit for charging a capacitor (C) with a PV panel. The circuit includes two switches (S1 and S2), and two resistors (R1 and R2). The intensity of the light incident on the PV panel remains constant throughout the whole experiment.



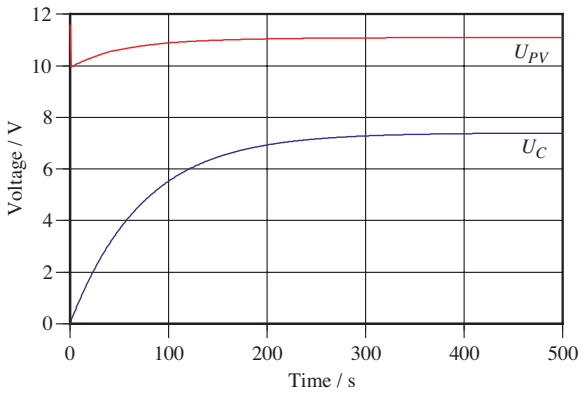
The characteristic curve of the PV-panel has been measured and plotted below. The intensity of the light falling upon the panel is constant during the experiment.



a. Determine the maximum value of the electric power (maximum power point, MPP) graphically. Describe briefly how you proceed. [1 P]

b. Determine the value of the load resistance R1 which would be needed to operate the PV-panel at the maximum power point right at the moment when we close switch S1 (S2 is still open!). [0.5 P]

Now we use C = 1.0 F, R_1 = 100 Ω and R_2 = 200 Ω in the circuit shown above. At t = 0, both switches S1 und S2 are closed and the voltage across the PV-panel (U_{PV}) and the capacitor (U_C) are measured. The result is shown in the figure below. An enlarged diagram can be found on the last page of this exam.



c. Formulate the equation of balance of the charge stored in the capacitor. [0.5 P]

d. Formulate the equation of balance of the energy stored in the capacitor. [0.5 P]

e. Calculate the strength of the electric current through R1 at time t = 0 s by using data from the graph above. [1 P]

f. Determine the electric power of the the resistor R1 at t = 0 s. [0.5 P]

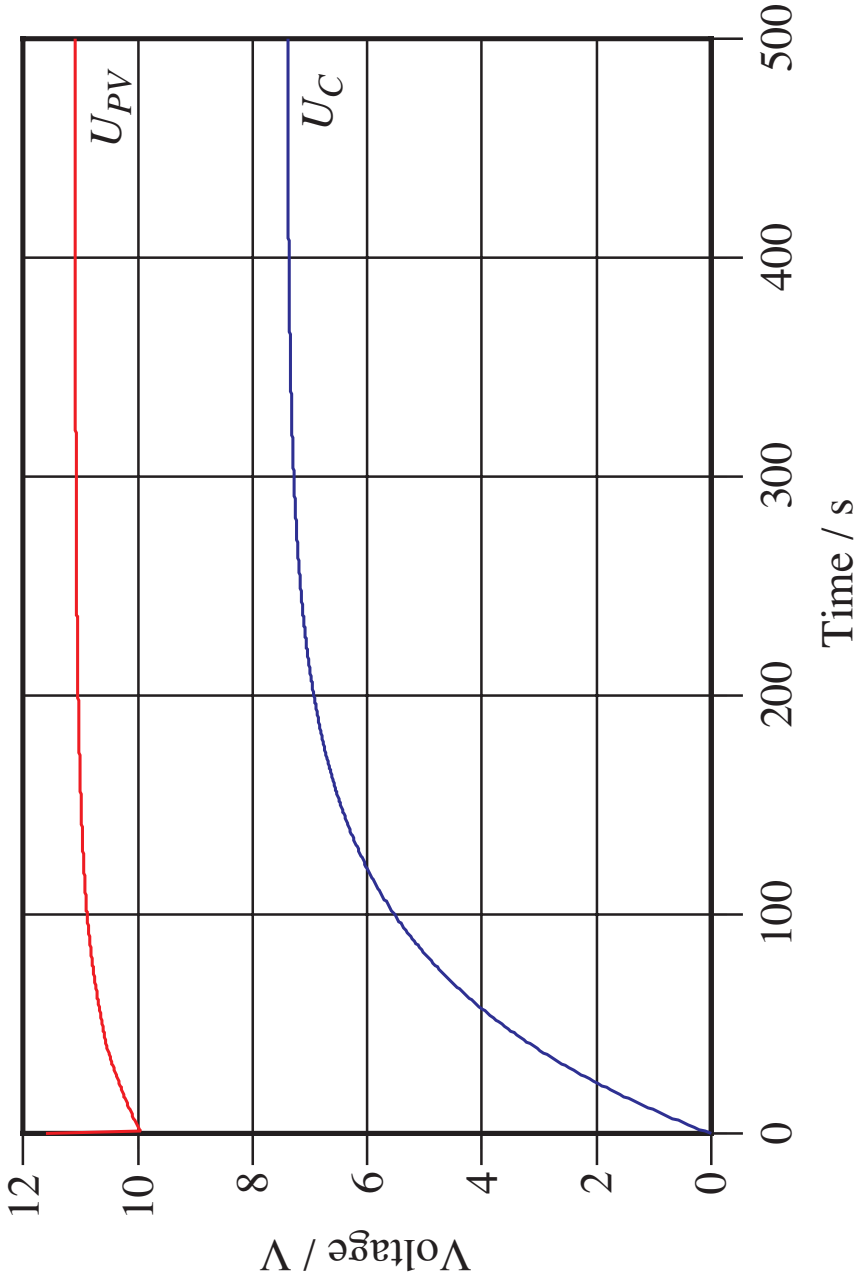
g. Determine as accurately as possible the energy current into the capacitor and the one leaving the capacitor as functions of time (use data from the graph). Plot both energy currents (y-Axis) as functions of time (x-axis) between t = 0 s and t = 500 s in a new diagramm [4 P]

h. Determine as accurately as possible the amount of energy leaving the capacitor between t = 0 s and t = 500 s. [2 P]

ADDITIONAL QUESTIONS

i. Calculate the change of energy of the capacitor between t = 0 s and t = 500 s. [1P]

j. Determine the amount of energy flowing into the capacitor between t = 0 s and t = 500 s. [1P]


U_{PV}
U_C
Voltage / V
Time / s
0
2
4
6
8
10
12
0
100
200
300
400
500