16. Internationale Elektrotechnik-Olympiade der Schulen der Euroregion Neisse

NEISSE - ELEKTRO 2000

Name:.....

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Tasks fort he finale test
90min ; with formula sheet (English edition)

1

Given is the electrical circuit according to figure **1**

$R_1 = 0{,}9\ \Omega \quad R_2 = 5\ \Omega$
$R_3 = R_4 = 2\ \Omega$
$R_5 = 1\ \Omega$
$R_6 = R_7 = 10\ \Omega$

$U_q = 20\ V$ und $R_i = 0{,}1\ \Omega$

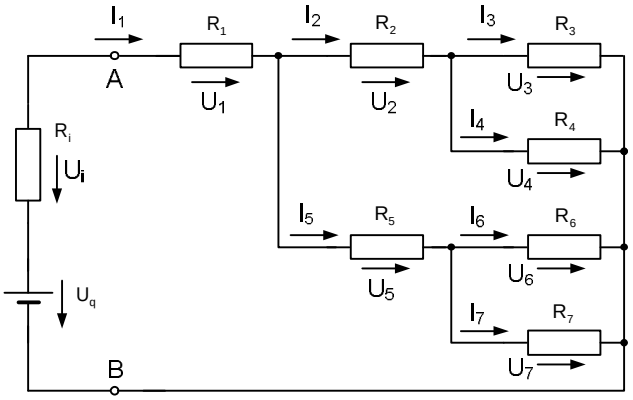

figure 1

Calculate the amounts of all currents from I_1 to I_7 and all voltages from U_1 to U_7 and U_i!

2

Connect four equal voltage sources (U_q = 1,5 V and R_i = 1 Ω) in that way, that the terminal voltage is 1. U = 6 V, 2. U = 3 V and 3. U = 1,5 V.

a) Draw the connections for the tree cases and calculate for each R_i and I_k!
b) Calculate the current I for each source in case of a additional load resistance of R_a = 2 Ω!
c) Give for each source the load resistance R_a, to achieve the maximum of power on R_a!

3

Calculate the mechanical force between two conductors of the length l = 1 m and with the distance of a = 5 cm and a direct current of I = 1 kA (according to figure 2).

Indicate the direction of force in figure 2 !

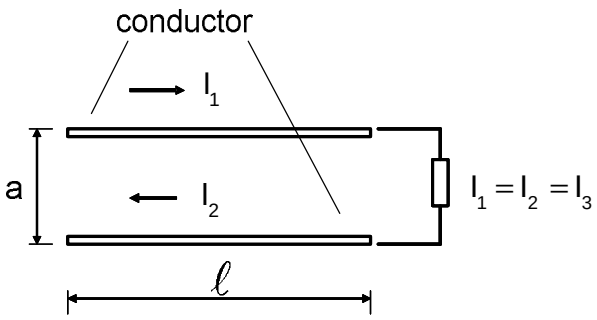

figure 2

4

A high voltage cable with U_o = 220 kV according to figure 3 can be considered as cylindrical capacitor.

a) Calculate the capacitance C of this cable with the following parameters:
   diameter of conductor d = 53 mm
   thickness of insulation D = 28 mm
   length of the cable l = 10 km
   $\varepsilon_r = 2,3$ and $f = 50\,Hz$

b) Calculate the capacitive charging current of this cable ($\omega = 2\,\pi f$)!

c) Calculate the length of the cable where the capacitive charging current is equal to the nominal current of the cable for a nominal current density of S = 2 A /mm²!

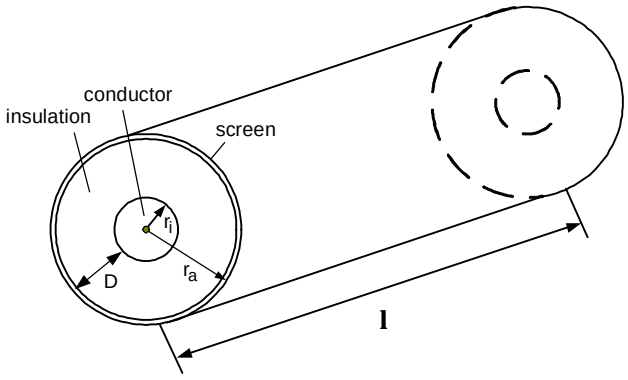

figure 3

5

A current I = 1000 A circulate in a quadratic conductor loop with a side length of S = 1 m.

a) Calculate the magnetic field strength H and the magnetic flux density B in the middle of the loop (point a) in figure 4!
b) Calculate H and B again for a point b) which is 50 cm above the point a)!

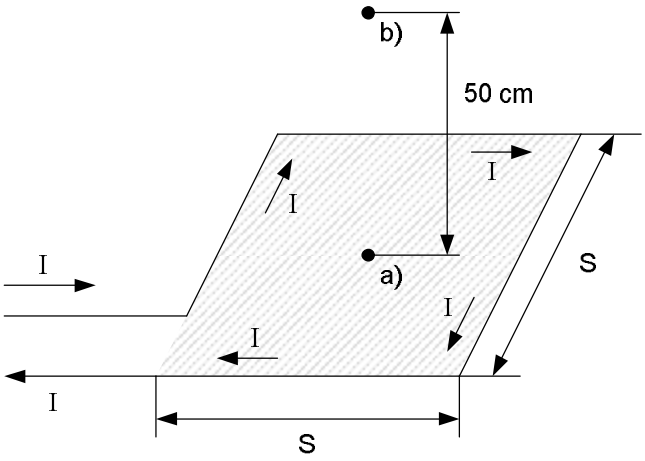

figure 4