ÉLEKTRONIKAI ALAPISMERETEK
ANGOL NYELVEN
FOUNDATIONS IN ELECTRONICS

2007. május 25. 8:00

KÖZÉPSZINTŰ
ÍRÁSBELI VIZSGA
STANDARD-LEVEL
WRITTEN EXAM

Az írásbeli vizsga időtartama: 180 perc
Duration of the written examination: 180 minutes

Pótlapok száma
Number of additional pages
Tisztázati / Final copy
Piszkozati / Draft

OKTATÁSI ÉS KULTURÁLIS
MINISZTÉRIUM
MINISTRY OF EDUCATION
AND CULTURE
Important Information

Only non-programmable calculators may be used while working on the written exam. Test questions should be answered on this test paper, using the available free place under the questions.

The solutions of other tasks will have to entered on the additional pages handed out by the invigilators. Additional pages should be numbered, and should bear the student’s identification number.

In the case of tasks requiring calculations, the correct relation (formula), the proper substitution and the correct calculation should be included. Failure to do so results in deduction of points. In certain cases where required, the substitution should be performed in normal form. The final result should be written in the following way:
Quantity to be calculated = numerical value x unit of measurement (e.g. R = 1.5 kΩ).
The final result can be accepted and the solution be awarded the maximum score if it correctly displays the numerical value and the unit of measurement.

While solving the tasks of the written exam, you should take care of properly arranging your text and maintaining a clear layout of your written exam paper. You should also pay attention to the use of standard symbols and to meeting the technical, aesthetic and format-related requirements. Failing to observe the above will in turn result in deduction of points.

Texts and figures on your exam paper deemed incorrect should be crossed out.

You should use a blue pen for writing texts and figures and a graphite pencil for preparing drawings.

During the working time you are allowed to make a final copy. If you decide to do so, one “Draft” and one “Final copy” should be prepared using continuous page numbering.
Test questions

Maximum points: 40

1.) Define the increase of the direct current resistance of the coil if the temperature increases from $T_1 = 20 \, ^\circ\text{C}$ to $T_2 = 80 \, ^\circ\text{C}$. The direct current resistance of the coil at 20 °C is $R_1 = 20 \, \Omega$, and the temperature coefficient is $\alpha = 0.004 \, 1/^\circ\text{C}$.

$$\Delta R =$$

2.) The table expresses the relation of the load resistance and the output voltage of an ideal current generator. Fill in the table.

<table>
<thead>
<tr>
<th>R (kΩ)</th>
<th>0</th>
<th>2</th>
<th>4</th>
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<tbody>
<tr>
<td>U (V)</td>
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</table>

3.) Define the resultant capacity of capacitors in serial combination.

Data: $C_1 = 12 \, \text{nF}$, $C_2 = 20 \, \text{nF}$, $C_3 = 30 \, \text{nF}$

$$C =$$

4.) Define the impedance of the R-C serial combination. Data: $R = 3 \, \text{kΩ}$, $X_C = 4 \, \text{kΩ}$

$$Z =$$

5.) Define the resultant current consumption of a parallel R-C combination if the branch current values are known. Data: $I_R = 80 \, \text{mA}$, $I_L = 60 \, \text{mA}$

$$I =$$

6.) Define the active power of the alternating current consumer.

Data: $U = 230 \, \text{V}$, $I = 8 \, \text{A}$, $\cos \phi = 0.8$

$$P =$$

7.) Define the differential resistance of the Zener diode in the region of operation assumed to be linear. Data: $I_{z\text{min}} = 5 \, \text{mA}$, $I_{z\text{max}} = 24 \, \text{mA}$, $U_{z\text{min}} = 11.8 \, \text{V}$, $U_{z\text{max}} = 12.2 \, \text{V}$

$$r_z =$$
8.) Define the $h_{21E}$ parameter of a bipolar transistor on the basis of the following measurement results: in the case of $I_{B1} = 20 \mu A I_{C1} = 4 mA$; in the case of $I_{B2} = 30 \mu A I_{C2} = 6 mA$.

The collector-emitter voltage is constant during the measurement period. (4 points)

$$h_{21E} =$$

9.) Define the output voltage of the power amplifier.

Data: $P_{out} = 100 W$, $R_l = 4 \Omega$ (3 points)

$$U_{ki} =$$

10.) Draw the circuit diagram of the basic inverting operational amplifier. The amplifier should contain 1 operational amplifier and 3 resistors. (3 points)

11.) Define the repetition frequency of a periodic square signal train.

The impulse width is $t_i = 200 \mu s$, the duty cycle is $k = 0.4$. (3 points)

$$f =$$

12.) Give the algebraic form of the logic function below. Please, mark the variable of the most significant place-value with “A”.

$F_4^4 = \Sigma^4 (3, 5, 10)$ (3 points)

$$F_4^4 =$$
Tasks

Task 1

Maximum points: 15

Calculation of direct current circuit parameters

![Circuit Diagram]

Data:

- $U_1 = 12 \text{ V}$
- $I_1 = 15 \text{ mA}$
- $R_1 = 300 \Omega$
- $R_2 = 750 \Omega$
- $I_5 = 10 \text{ mA}$
- $R_5 = 600 \Omega$

Tasks:

a) Define the voltages ($U_2$, $U_3$, $U_5$) of resistors $R_2$, $R_3$ and $R_5$.
b) Define the currents ($I_2$, $I_3$, $I_4$) of resistors $R_2$, $R_3$ and $R_4$.
c) Define the resultant resistance ($R_r$) between the terminals of the network.

Task 2

Maximum points: 15

Calculations of R-C parallel combination parameters

![RC Circuit Diagram]

Data:

- $C = 100 \text{ nF}$
- $R = 1.5 \text{ k}\Omega$
- $U = 5 \text{ V}$
- $f = 1 \text{ kHz}$

Tasks:

a) Define the current values ($I_C$, $I_R$, $I$).
b) Define the impedance ($Z$) of the combination.
c) Define the phase-angle ($\varphi$) between the supply voltage ($U$) and the supply current.
**Task 3**

**Maximum point: 15**

**Calculation of common emitter amplifier parameters**

Tasks:

a) Define the input and output resistances ($R_{in}$, $R_{out}$) of the stage.

b) Define the value of the voltage amplification ($A_u$).

c) Define the value of the output voltage. The unloaded source voltage is $u_g = 10 \text{ mV}$ and the internal resistance is $R_g = 1 \text{k}\Omega$ at the controlling signal source.

**Data:**

$R_{B1} = 75 \text{k}\Omega$  \quad $R_{B2} = 30 \text{k}\Omega$

$R_C = 3 \text{k}\Omega$  \quad $R_E = 1.5 \text{k}\Omega$

$R_1 = 4 \text{k}\Omega$

$h_{11E} = 4 \text{k}\Omega$  \quad $h_{21E} = 180$

$h_{22E} = 20 \mu\text{S}$

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**Task 4**

**Maximum points: 15**

**Design of combinatorial circuit**

The Veitch diagram of the logic function:

```
  C
 / \
A  B
```

Tasks:

a) Give the canonical form of the function.

b) Simplify the function by graphic methods.

c) Implement functions with NOT, AND and OR gates. The variables are available only in ponated form.

d) Implement the function with NOR gates.
   (The variables are available only in ponated form.)
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<tr>
<th>Topic</th>
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<th>Points scored</th>
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Points of written exam: 100

Correcting teacher

Date: .........................

Elért pontszám
Points scored

Programba beírt pontszám
Points entered into programme

Teszt
Test

Feladatsor
Tasks

Javitó tanár / Correcting teacher

Dátum / Date: .........................

Jegyző / Notary

Dátum / Date: .........................