ELEKTRONIKAI ALAPISMERETEK
ANGOL NYELVEN
FOUNDATIONS IN ELECTRONICS

KÖZÉPSZINTŰ
ÉRETTSÉGI VIZSGA
STANDARD LEVEL
BACCALAUREATE
WRITTEN EXAM

JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ
CORRECTION AND
EVALUATION GUIDE

OKTATÁSI ÉS KULTURÁLIS
MINISZTÉRIUM
MINISTRY OF EDUCATION
AND CULTURE
Test questions

Maximum points: 40

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

$$\Delta R = \alpha \cdot R_1 \cdot (T_2 - T_1) = 0.004 \times 20 \Omega \cdot (80^\circ C - 20^\circ C) = 4.8 \, \Omega$$

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 (k\Om)</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>U (V)</td>
<td>0</td>
<td>4</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

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

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

$$C = C_1 \times C_2 \times C_3 = 12 \times 20 \times 30 \, nF = 6 \, \mu F$$

4.) Define the impedance of the R-C serial combination. Data: $R = 3 \, k\Omega$, $X_C = 4 \, k\Omega$

$$Z = \sqrt{R^2 + X_C^2} = \sqrt{(3 \, k\Omega)^2 + (4 \, k\Omega)^2} = 5 \, k\Omega$$

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

$$I = \sqrt{I_R^2 + I_L^2} = \sqrt{(80 \, mA)^2 + (60 \, mA)^2} = 100 \, mA$$

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

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

$$P = U \cdot I \cdot \cos \phi = 230 \, V \cdot 10 \, A \cdot 0.8 = 1.84 \, kW$$

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

$$r_z = \frac{\Delta U_z}{\Delta I_z} = \frac{U_{z_{\text{max}}} - U_{z_{\text{min}}}}{I_{z_{\text{max}}} - I_{z_{\text{min}}}} = \frac{12.2 \, V - 11.8 \, V}{24 \, mA - 5 \, mA} = 21.05 \, \Omega$$
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.

$$h_{21E} = \frac{I_{C2} - I_{C1}}{I_{B2} - I_{B1}} = \frac{6 \, mA - 4 \, mA}{30 \mu A - 20 \mu A} = 200$$

4 points

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

Data: $P_{out} = 100 \, W$, $R_l = 4 \, \Omega$

$$U_{ki} = \sqrt{P_{ki} \cdot R_1} = \sqrt{100 \, W \cdot 4 \, \Omega} = 20 \, V$$

3 points

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 $k = 0.4$

$$f' = \frac{1}{T} = \frac{1}{t_i} \cdot \frac{k}{t_k} = \frac{0.4}{200 \, \mu s} = 2kHz$$

3 points

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

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

$$F^4 = \overline{A} \cdot \overline{B} \cdot C \cdot D + \overline{A} \cdot B \cdot \overline{C} \cdot D + A \cdot \overline{B} \cdot C \cdot \overline{D}$$

3 points
Tasks Maximum points: 60

Solution of task 1

Maximun points: 15

a) \[ U_2 = U_i - I_1 \cdot R_1 = 12V - 15mA \cdot 300\Omega = 7.5V \]
   \[ U_5 = I_5 \cdot R_5 = 10mA \cdot 600\Omega = 6V \]
   \[ U_3 = U_2 - U_5 = 7.5V - 6V = 1.5V \]

b) \[ I_2 = \frac{U_2}{R_2} = \frac{7.5V}{750\Omega} = 10mA \]
   \[ I_3 = I_1 - I_2 = 15mA - 10mA = 5mA \]
   \[ I_4 = I_5 - I_3 = 10mA - 5mA = 5mA \]

\[ R = \frac{U_1}{I_1 + I_4} = \frac{12V}{15mA + 5mA} = 600\Omega \]

Solution of task 2

Maximium points: 15

\[ X_c = \frac{1}{2 \cdot \pi \cdot f \cdot C} = \frac{1}{2 \cdot \pi \cdot 10^3Hz \cdot 10^{-9}F} = 1.59k\Omega \]

\[ I_c = \frac{U}{X_c} = \frac{5V}{1.59k\Omega} = 3.14mA \]

\[ I_R = \frac{U}{R} = \frac{5V}{1.5k\Omega} = 3.33mA \]

\[ I = \sqrt{I_R^2 + I_C^2} = \sqrt{(3.33mA)^2 + (3.14mA)^2} = 4.58mA \]

b) \[ Z = \frac{U}{I} = \frac{5V}{4.58mA} = 1.09k\Omega \]

c) \[ \cos \varphi = \frac{I_R}{I} = \frac{3.33mA}{4.58mA} = 0.727 \Rightarrow \varphi = 43.4^\circ \]
Task 3 Maximum points: 15

a) \[ R_{in} = R_{B1} \times R_{B2} \times h_{11E} = 75 \, k\Omega \times 30 \, k\Omega \times 4 \, k\Omega = 3.37 \, k\Omega \] 

3 points

\[ R_{out} = \frac{1}{h_{22E}} \times R_C = \frac{1}{20 \, \mu S} \times 3 \, k\Omega = 2.83 \, k\Omega \] 

3 points

b) \[ A_u = -\frac{h_{11E}}{h_{11E}} \left( R_{out} \times R_t \right) = -\frac{180}{4 \, k\Omega} (2.83 \, k\Omega \times 4 \, k\Omega) = -74.6 \] 

4 points

c) \[ u_{in} = u_g \frac{R_{in}}{R_g + R_{in}} = 10 \, mV \frac{3.37 \, k\Omega}{1 \, k\Omega + 3.37 \, k\Omega} = 7.71 \, mV \] 

3 points

\[ u_{out} = A_u \cdot u_{in} = -74.6 \cdot 7.71 \, mV = -575.2 \, mV \] 

2 points

Task 4 Maximum points: 15

a) \[ F^4 = \Pi^4 (1, 2, 3, 6, 7, 10, 11, 14, 15) \] 

2 points

b) 

\[ F^4 = C \cdot (\overline{A} + \overline{B} + D) \] 

3 points

c) 

\[ F^4 = C \cdot (\overline{A} + \overline{B} + D) = C \cdot (\overline{A} + \overline{B} + D) = \overline{C + A + B + D} \] 

4 points

d) 

\[ F^4 = C \cdot (\overline{A} + \overline{B} + D) = C \cdot (\overline{A} + \overline{B} + D) = \overline{C + A + B + D} \] 

2 points

\[ F^4 \] 

4 points
**Rules Governing the Evaluation of the Written Exam**

Evaluation of the solutions of the test questions and other tasks must be carried out in line with the centrally compiled correction and evaluation guide.

Information about the maximum points available for individual test questions and other tasks is contained in the document entitled Solutions of the Written Exam of the Professional Preparatory Baccalaureate. When evaluating solutions of tasks also requiring calculation (sizing), actual points should be allocated in line with the table below:

<table>
<thead>
<tr>
<th>Quantitative aspects</th>
<th>Qualitative aspects</th>
<th>Documentation of the solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas of assessment</td>
<td>Areas of assessment</td>
<td>Areas of assessment</td>
</tr>
<tr>
<td>Ratio</td>
<td>Ratio</td>
<td>Ratio</td>
</tr>
</tbody>
</table>

- **completeness of solution**: 70%
- **logic of the solution**: 20%
- **creativity**: 20%
- **accuracy**: 20%
- **proper use of units of measurement**: 20%
- **arrangement**: 10%
- **layout**: 10%
- **use of standard symbols**: 10%
- **conformity to technical, aesthetical and format-related requirements**: 10%

In light of the above, maximum points can only be granted if requirements concerning quantitative aspects, qualitative aspects and the documentation of the solution are fully satisfied.

**Scoring of test questions**

**Question 1** (4 points)
2 points for formula, 1 point for substitution, 1 point for result.

**Question 2** (4 points)
Actual points equal the number of correct answers. Minimum 0 point, maximum 4 points.

**Question 3** (3 points)
1 point for formula, 1 point for substitution, 1 point for result.

**Question 4** (3 points)
1 point for formula, 1 point for substitution, 1 point for result.

**Question 5** (3 points)
1 point for formula, 1 point for substitution, 1 point for result.

**Question 6** (3 points)
1 point for formula, 1 point for substitution, 1 point for result.

**Question 7** (4 points)
2 points for formula, 1 point for substitution, 1 point for result.

**Question 8** (4 points)
2 points for formula, 1 point for substitution, 1 point for result.

**Question 9** (3 points)
1 point for formula, 1 point for substitution, 1 point for result.

**Question 10** (3 points)
2 points for professionally correct network, 1 point for the use of standard symbols.
Question 11  
1 point for formula, 1 point for substitution, 1 point for result.  
(3 points)

Question 12  
3 points for accurate algebraic form. 1-point deduction for each error; minimum zero points.  
(3 points)

The General Rules Governing the Quantitative Evaluation of Tasks

Professionally correct solutions not appearing in the evaluation guide must equally be accepted and allocated the indicated number of points. Maximum points for a task (part of the task) can only be allocated for the examinee if the data are properly substituted in the formula, and further, if the final result is calculated accordingly.

In certain cases, the use of normal form data should be required. The final result can only be deemed acceptable if the value and the unit of measurement of the final result are appropriate. The minimum point that can be awarded for part of a task is 1 point, fewer than 1 point cannot be awarded in any case.

Concerning related parts of one task, in the event that the result of any part of the given task is incorrect and if this incorrect result is used in any subsequent parts of the given task (parts of the task), the points indicated for the correct solution appearing in the guide should be awarded provided the solution is otherwise correct.

Nevertheless, as appropriate, the following will result in deduction of points:
- the partial result used in any subsequent parts of the task is professionally impossible or extreme,
- the partial result used leads to decreased complexity of problem solving in the case of subsequent part or parts of the given task.

Scoring of the tasks

Task 1  
Maximum points: 15

a) When calculating \( U_2 \), formula: 1 point, substitution: 1 point, result: 1 point. When calculating \( U_5 \) and \( U_3 \) respectively, formula: 1 point, substitution: 1 point, result: 1 point. 7 points altogether.
b) When calculating \( I_2, I_3 \) and \( I_4 \) respectively, formula: 1 point, substitution: 1 point, result: 1 point. 6 points altogether.
c) Formula: 1 point, substitution: 1 point, result: 1 point. 2 points altogether.

Task 2  
Maximum points: 15

a) When calculating \( X_C \) and \( I \) respectively, formula: 1 point, substitution: 1 point, result: 1 point. When calculating \( I_C \) and \( I_R \) respectively, formula: 1 point, substitution: 1 point, result: 1 point. 10 points altogether.
b) When calculating \( Z \), formula: 1 point, substitution and result: 1 point. 2 points altogether.
c) When calculating \( \phi \), formula: 1 point, substitution: 1 point, result: 1 point. 3 points altogether.
Task 3  
Maximum points: 15

a) When calculating $R_{in}$ and $R_{out}$ respectively, formula: 1 point, substitution and result: 1 point.  
   **6 points** altogether.

b) When calculating $A_{in}$, formula: 2 points, substitution and result: 1 point.  
   **4 points** altogether.

c) When calculating $u_{in}$, formula: 1 point, substitution: 1 point, result: 1 point.  
   When calculating $u_{out}$, formula: 1 point, substitution: 1 point, result: 1 point.  
   **5 points** altogether.

Task 4  
Maximum points: 15

a) Maximum **2 points** for correct solution. Formally correct conjunctive canonical form: 1 point, correct serial number 1 point.

b) Maximum **3 points** for correct solution. Logically correct but not the simplest form: 1 point deduction.

c) Maximum **4 points** for correct solution. Solution logically correct but contains more than four gates: maximum 3 points.

d) Maximum **6 points** for correct solution. Failing to give another form of the function does not result in deduction of points if the implementation is correct, with a maximum of 5 NAND gates. Maximum 4 points for task c) if solution is logically correct but contains more than 5 gates.

The allocation of the above-mentioned points takes into consideration quantitative aspects. Points calculated this way can be decreased to the extent indicated in the table if qualitative criteria are not met or the documentation of the task is not appropriate.