

ÉRETTSÉGI VIZSGA • 2006. május 18.

**ELEKTRONIKAI ALAPISMERETEK
ANGOL NYELVEN
FOUNDATIONS
IN ELECTRONICS**

**KÖZÉPSZINTŰ ÍRÁSBELI
ÉRETTSÉGI VIZSGA
STANDARD LEVEL WRITTEN
BACCALAUREATE
EXAMINATION**

**JAVÍTÁSI-ÉRTÉKELÉSI
ÚTMUTATÓ
CORRECTION-EVALUATION
GUIDE**

**OKTATÁSI MINISZTERIUM
MINISTRY OF EDUCATION**

Solutions of test questions

Maximum points: 40

- 1.) Define the resultant resistance of the given resistors connected in parallel combination.
Data: $R_1 = 6 \text{ k}\Omega$, $R_2 = 20 \text{ k}\Omega$, $R_3 = 30 \text{ k}\Omega$.

$$R = R_1 \times R_2 \times R_3 = 6 \text{ k}\Omega \times 20 \text{ k}\Omega \times 30 \text{ k}\Omega = \underline{\underline{4 \text{ k}\Omega}} \quad 3 \text{ points}$$

- 2.) The table expresses the relation of the load resistance and load current of a voltage generator. Fill in the table.

R (k Ω)	2	4	8	16	32
I (mA)	8	4	2	1	0.5

4 points

- 3.) Define the biggest allowed voltage connectable to a resistor of $R = 300 \text{ }\Omega$, with allowed power $P = 2 \text{ W}$.

$$U = \sqrt{P \cdot R} = \sqrt{2 \text{ W} \cdot 300 \text{ }\Omega} = \underline{\underline{24.49 \text{ V}}} \quad 3 \text{ points}$$

- 4.) In the table below, fill in the missing figures of the momentary values of sinusoidal alternating voltage of effective value $U = 2$ and $f = 1 \text{ kHz}$ at given points of time elapsed from the beginning of the period.

t (μs)	0	250	500	750	1000
u (V)	0	2.83	0	-2.83	0

3 points

- 5.) The table below expresses the frequency dependence of capacitive reactance. Fill in the table.

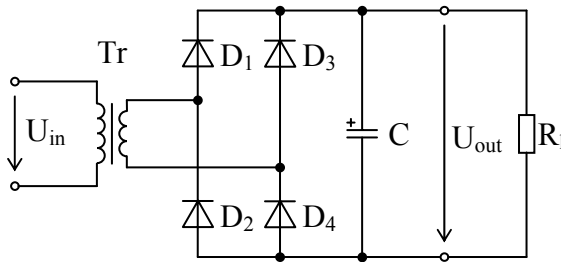
f (kHz)	1	2	4	8	16
X_C (k Ω)	80	40	20	10	5

4 points

- 6.) Define the effective value of alternating voltage that supplies the serial RL combination if $U_R = 40 \text{ V}$, $U_L = 30 \text{ V}$.

$$U = \sqrt{U_R^2 + U_L^2} = \sqrt{(40 \text{ V})^2 + (30 \text{ V})^2} = \underline{\underline{50 \text{ V}}} \quad 3 \text{ points}$$

- 7.) Draw the circuit diagram of a Graetz rectifier. The circuit diagram should also contain a mains transformer and a buffer capacitor.



4 points

- 8.) Define the slope of a bipolar transistor. Available transistor data:
 $h_{11E} = 4 \text{ k}\Omega$, $h_{21E} = 180$

$$S = \frac{h_{21E}}{h_{11E}} = \frac{180}{4 \text{ k}\Omega} = \underline{\underline{45 \text{ mS}}}$$

3 points

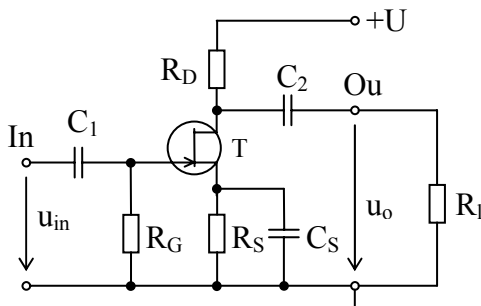
- 9.) Define the power amplification of the amplifier.

Data: $u_{in} = 10 \text{ mV}$, $i_{in} = 1 \text{ }\mu\text{A}$, $u_{out} = 0.8 \text{ V}$, $i_{out} = 100 \text{ }\mu\text{A}$.

$$A_p = \frac{p_{ki}}{p_{be}} = \frac{u_{ki} \cdot i_{ki}}{u_{be} \cdot i_{be}} = \frac{0.8 \text{ V} \cdot 10^{-4} \text{ A}}{10^{-2} \text{ V} \cdot 10^{-6} \text{ A}} = \underline{\underline{8 \cdot 10^3}}$$

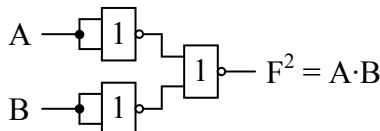
3 points

- 10.) Draw the basic connection of the common source amplifier. The connection should contain 1 N-channel junction FET 3 resistors (R_G , R_D , R_S) and 3 capacitors.



4 points

- 11.) Draw a logic network that implements a two variable AND logic function with two input NOR gates.



3 points

- 12.) Give the canonical form of the logic function below. The most significant place-value has been marked "A".

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

3 points

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

Solutions

Maximum points: 60

Solution of task 1

Maximum points: 15

a) $R_e = R_1 + [R_2 \times (R_3 + R_4)] = 4\Omega + [36\Omega \times (12\Omega + 24\Omega)] = \underline{\underline{22\Omega}}$ **3 points**

b) $I = \frac{U_k}{R_e} = \frac{44\text{V}}{22\Omega} = \underline{\underline{2\text{A}}}$ **2 points**

c) $U_g = U_k + I \cdot R_g = 44\text{V} + 2\text{A} \cdot 2\Omega = \underline{\underline{48\text{V}}}$ **2 points**

$U_2 = U_k - I \cdot R_1 = 44\text{V} - 2\text{A} \cdot 4\Omega = \underline{\underline{36\text{V}}}$ **2 points**

d) $I_3 = I_4 = \frac{U_2}{R_3 + R_4} = \frac{36\text{V}}{12\Omega + 24\Omega} = \underline{\underline{1\text{A}}}$ **2 points**

$U_3 = I_3 \cdot R_3 = 1\text{A} \cdot 12\Omega = \underline{\underline{12\text{V}}}$ **2 points**

$U_4 = U_2 - U_3 = 36\text{V} - 12\text{V} = \underline{\underline{24\text{V}}}$ **2 points**

Solution of task 2

Maximum points: 15

a) $L = \frac{1}{4 \cdot \pi^2 \cdot f_0^2 \cdot C} = \frac{1}{4 \cdot \pi^2 \cdot 10^{12} \text{ Hz}^2 \cdot 10^{-10} \text{ F}} = \underline{\underline{253\mu\text{H}}}$ **3 points**

b) $X_L = 2 \cdot \pi \cdot f_0 \cdot L = 2 \cdot \pi \cdot 10^6 \text{ Hz} \cdot 2.53 \cdot 10^{-4} \text{ H} = \underline{\underline{1.59\text{k}\Omega}}$ **3 points**

$r = \frac{X_L}{Q} = \frac{1590\Omega}{50} = \underline{\underline{31.8\Omega}}$ **2 points**

c) $I = \frac{U}{r} = \frac{1\text{V}}{31.8\Omega} = \underline{\underline{31.4\text{mA}}}$ **2 points**

d) $U_C = U_L = Q \cdot U = 50 \cdot 1\text{V} = \underline{\underline{50\text{V}}}$ **3 points**

e) $B = \frac{f_0}{Q} = \frac{1\text{MHz}}{50} = \underline{\underline{20\text{kHz}}}$ **2 points**

Solution of task 3

Maximum points: 15

a) $i_{in} = \frac{u_1 - u_2}{R_S} = \frac{15\text{mV} - 10\text{mV}}{5\text{k}\Omega} = 1\mu\text{A}$ $R_{in} = \frac{u_2}{i_{in}} = \frac{10\text{mV}}{1\mu\text{A}} = \underline{\underline{10\text{k}\Omega}}$ **4 points**

b) $\frac{R_{out}}{R_l} = \frac{u_{3ü} - u_{3t}}{u_{3t}} \Rightarrow R_{out} = R_l \cdot \frac{u_{3ü} - u_{3t}}{u_{3t}} = 3\text{k}\Omega \cdot \frac{2\text{V} - 1.5\text{V}}{1.5\text{V}} = \underline{\underline{1\text{k}\Omega}}$ **3 points**

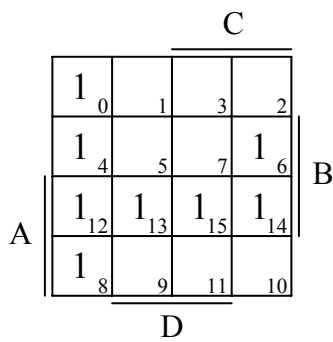
c) $A_{uüi} = \frac{u_{3ü}}{u_2} = \frac{2\text{V}}{10^{-2}\text{V}} = \underline{\underline{200}}$ $A_{ut} = \frac{u_{3t}}{u_2} = \frac{1.5\text{V}}{10^{-2}\text{V}} = \underline{\underline{150}}$ **4 points**

d) $A_i = A_{ut} \cdot \frac{R_{in}}{R_l} = 150 \cdot \frac{10\text{k}\Omega}{3\text{k}\Omega} = \underline{\underline{500}}$ **2 points**

$A_p = A_{ut} \cdot A_i = 150 \cdot 500 = \underline{\underline{75,000}}$ **2 points**

Solution of task 4 Maximum points: 15

a)

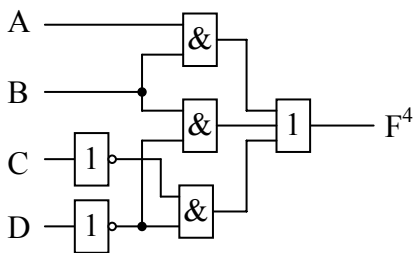


2 points

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

3 points

b)

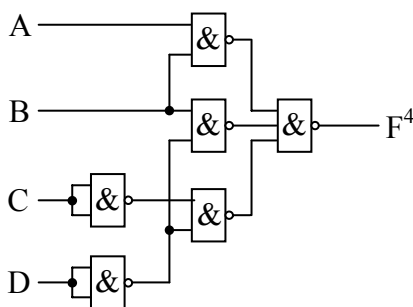


4 points

c)

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

2 points



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:

Quantitative aspects		Qualitative aspects		Documentation of the solution	
Areas of assessment	Ratio	Areas of assessment	Ratio	Areas of assessment	Ratio
<ul style="list-style-type: none"> completeness of solution 	70%	<ul style="list-style-type: none"> logic of the solution creativity accuracy proper use of units of measurement 	20%	<ul style="list-style-type: none"> arrangement layout use of standard symbols 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** (3 points)
1 point 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)
Actual points equal the number of correct answers. Minimum 0 point, maximum 3 points.
- Question 5** (4 points)
Actual points equal the number of correct answers. Minimum 0 point, maximum 4 points.
- Question 6** (3 points)
1 point for formula, 1 point for substitution, 1 point for result.
- Question 7** (4 points)
3 points for professionally correct circuit diagram, 1 point for the use of standard symbols.
- Question 8** (3 points)
1 point 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)
3 points for professionally correct circuit diagram, 1 point for the use of standard symbols.

Question 11 **(3 points)**

2 points for professionally correct circuit diagram, 1 point for the use of standard symbols.

Question 12 **(3 points)**

1 point for formally correct conjunctive canonical forms, 2 points for appropriate serial numbers.

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 where required, 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) Formula: 1 point, substitution: 1 point, result: 1 point. **3 points** altogether.
- b) When calculating I , substitution and result: 1 point, **2 points** altogether.
- c) When calculating U_g and U_2 respectively, formula 1 point, substitution and result 1 point. **4 points** altogether.
- d) When calculating I_3 , U_3 and U_4 respectively, formula 1 point, substitution and result: 1 point. **6 points** altogether.

Task 2

Maximum points: 15

- a) When calculating L , formula: 1 point, substitution 1 point, result 1 point. **3 points** altogether.
 - b) When calculating X_L , formula: 1 point, substitution 1 point, result 1: point.
When calculating r , formula: 1 point, substitution and result: 1 point. **5 points** altogether.
 - c) When calculating I , formula: 1 point, substitution and result 1 point. **2 points** altogether.
 - d) When calculating U_C and U_L , formula: 1 point, substitution: 1 point, result: 1 point.
3 points altogether. In the case of defining only one of U_C or U_L , maximum 2 points.
 - e) When calculating B , formula 1: point, substitution and result 1. **2 points** altogether.
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Task 3

Maximum points: 15

- a) When calculating i_{in} and R_{in} respectively, formula: 1 point, substitution and result: 1 point. **4 points** altogether.
- b) When calculating R_{out} , formula: 1 point, substitution: 1 point, result: 1 point. **3 points** altogether.
- c) When calculating $A_{uü}$ and A_{ut} respectively, formula: 1 point, substitution and result: 1 point. **4 points** altogether.
- d) When calculating A_i and A_p respectively, formula: 1 point, substitution and result: 1 point. **4 points** altogether.

Task 4

Maximum points: 15

- a) Maximum **5 points** for the correct solution. Filled in Veitch table: 2 points, simplified function: 3 points. In the case of giving a form that is logically correct but it is not the simplest form: 1 point deduction.
- b) Maximum **4 points** for the correct solution. In the case of a logically correct solution containing more than six gates: maximum 3 points.
- c) Maximum **6 points** for the 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 6 NAND gates. Maximum 4 points for task c) if solution is logically correct but contains more than 6 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.