TEST

The participants shall select one answer out of 5 possible answers in the answer sheet for each question (A, B, C, D, E) by crossing lines from the top left corner to the bottom right corner and form the bottom left corner to the top right corner (as it is shown below).



In the case of crossing out more than one answer for the same question or making any other notes, the answer to that question will be scored 0.



Participant

University

1. What will be the output frequency if the input clock signal is 3600MHz?



VDD

A

M1

M2

В

Ā

M3

M4

Vout

- **2.** What logic function is implemented by the circuit shown in the figure?
 - A. OR
 - B. XNOR
 - C. XOR
 - D. NAND
 - E. NOR



- A. L channel length
- B. W channel width
- C. V_{DS} drain voltage
- D. Channel length, width and drain's V_{DS} voltage
- E. All the answers are correct
- 4. The following is not operating domain of $I_{DS} = f(V_{DS})$ characteristic of a MOS transistor with induced channel:
 - A. Linear domain
 - B. Saturation domain
 - C. Cut-off domain
 - D. Breakdown domain
 - E. Linear and saturation domains
- 5. Which of the following digital devices can determine which of the two codes is larger?
 - A. Encoder
 - B. Decoder
 - C. Multiplexer
 - D. Comparator
 - E. Distributor
- 6. Which of the given graphs gives the possibility of describing multi-branch chains?
 - A. Directed graph
 - B. Acyclic graph
 - C. Hypergraph
 - D. Multigraph
 - E. Not-linked graph

- 7. What function can be implemented by this circuit?
 - A. Second-order high-pass filter
 - B. Layer filter
 - C. Blocking (rejector) filter
 - D. Second order low-pass filter
 - E. All the answers are wrong



- 8. What function can be implemented by this circuit?
 - A. High frequency filter amplifier
 - B. Sinusoidal signal generator
 - C. Rectangular pulse generator
 - D. Low-pass filter-amplifier
 - E. All the answers are wrong



x1

 R_3

- **9.** Determine what function is implemented by this circuit.
 - *A. y*=*x*1⊕*x*2⊕~*x*3
 - *B. y*=*x*1⊕*x*2⊕*x*3
 - *C. y=x1⊕*~*x2⊕x3*
 - D. ~x1⊕x2⊕x3
 - E. No correct answer
- **10.** What values will be set in the following flags when adding two signed 8-bit numbers 45 and -45. CF carry flag, ZF zero flag, SF sign flag, PF parity flag, OF-overflow flag
 - A. CF = 0, ZF =0, OF =1, SF = 1, PF =0
 - B. CF = 0, ZF = 1, OF = 1, SF = 1, PF = 0
 - C. CF =1, ZF =1, OF =0, SF = 0, PF =1
 - D. CF =1, ZF =1, OF =0, SF = 1, PF =1
 - E. No correct answer
- **11.** How many different roots does the following equation have?

x	1	2	3	•••	2022	
1	x	2	3	•••	2022	
1	2	x	3	•••	2022	_0
1	2	3	x	•••	2022	=0
	•••	•••	•••		•••	
1	2	3	4	•••	x	

A. 1

- B. 2023
- C. 2022
- D. 2021
- E. 2020

12. Evaluate $\lim_{n \to \infty} n \int_{0}^{1} x^{n} e^{5x - 3x^{2}} dx$

- *A.* 1
- В. е
- $C. e^2$
- D. e^3
- E. e^4
- **13.** Consider the simple OR gate with input lines A and B. The input line A has a single stuck-at-0 fault. Find the correct answer among the 5 statements below:
 - A. The fault "A stuck-at-0" is undetectable
 - B. Input vector (A,B)=(0,0) is a test for detection of the fault "A s-a-0"
 - C. Input vector (A,B)=(0,1) is a test for detection of the fault "A s-a-0"
 - D. Input vector (A,B)=(1,0) is a test for detection of the fault "A s-a-0"
 - E. Input vector (A,B)=(1,1) is a test for detection of the fault "A s-a-0"
- **14.** Consider the simple AND gate with input lines A and B. Among the 5 statements listed below, choose the correct answer:
 - A. The fault "A stuck-at-1" is not detectable
 - B. The input pattern (A,B)=(0,0) is a test detecting the fault "A stuck-at-1"
 - C. The input pattern (A,B)=(0,1) is a test detecting the fault "A stuck-at-1"
 - D. The input pattern (A,B)=(1,0) is a test detecting the fault "A stuck-at-1"
 - E. The input pattern (A,B)=(1,1) is a test detecting the fault "A stuck-at-1"



- A. Because the number of free charge carriers decreases
- B. Because the number of free charge carriers increases
- *C.* Because the work function of electrons decreases
- D. Because the band gap increases
- E. Because the number of surface states decreases
- **16.** Why does the resistance decrease when it is illuminated?
 - A. Because the light reflects off the surface of the semiconductor
 - B. Because illumination generates free charge carriers
 - C. Because the illumination is not absorbed in the bulk of the semiconductor
 - D. Because the energy of the absorbed photons is less than the band gap
 - E. Because the illumination passes through the semiconductor without absorption
- **17.** Which formula is the correct formula for common-mode gain?
 - $A. \quad g_m R_D$

$$B. \quad \frac{g_m R_S}{1 + (g_m + g_{mb}) R_S}$$

 $C. \quad \frac{-g_m R_D}{1+g_m R_S}$

$$D. -g_m R_D$$

$$E_{*} = \frac{-\frac{K_D/2}{1/(2g_m) + R_{SS}}}{1/(2g_m) + R_{SS}}$$





- 18. What statement is correct about common source amplifier with source degeneration?
 - A. It has bigger gain than without degeneration version
 - B. Linearity of amplifier is bigger compared with without degeneration version
 - C. It will result to phase shift from input to output to be 360 degrees
 - D. Output voltage swing will increase compared with without degeneration version
 - E. Power consumption will increase compared with without degeneration version
- 19. What will be the output of the following code?

```
{
    int k = 8;
    int x = 0 == 1 && k++;
    printf ("%d%d\n", x, k);
}
A. 09
```

- B. 08
- C. 18
- D. 19
- E. 21
- **20.** What is the time complexity of the following code?

```
int i = 1, s =1;
while (s <= n)
{
    i++;
    s += i;
}</pre>
```

- A. O (n)
- B. O (log)
- C. O (Vn)
- D. O (nlogn)
- E. No correct answer

21. What logic function is implemented by the presented circuit?

- A. AND
- B. XOR-XNOR
- C. AND-NAND
- D. OR-NOR
- E. MUX-MUXI



22. Which is the Canonical Disjunctive Normal Form (CDNF) of the function described by the following truth table?

	Inputs	Output	
а	b	С	У
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

- A. y=!a&b&!c+!a&b&c+a&b&!c+a&b&c
- B. y=!a&!b&!c+!a&!b&c+a&!b&!c+a&!b&c
- C. y=(a+b+c)&(a+b+!c)&(!a+b+c)&(!a+b+!c)
- $D. \quad y = (!a + !b + !c) \& (!a + !b + c) \& (a + !b + !c) \& (a + !b + c)$
- *E.* y=(a+!b+c)&(a+!b+!c)&(!a+!b+c)&(!a+!b+!c)

23. In the operation of a typical active-mode BJT transistor, the topology opposite is:



- A. A common-base connection
- B. A common-emitter connection
- C. A common-collector connection
- D. A common-base and common-emitter connection
- E. None of the above
- **24.** What is the reason for the occurrence of negative differential conductance region on the emitter current I_e dependence on base voltage V_{EB1} in case of a single junction transistor?
 - A. P + n-junction breakdown
 - B. Strong injection of holes into base
 - C. Electron injection from ohmic B1- contact
 - D. Impact ionization phenomena in the base
 - E. A. and C. answers are correct



- **25.** A password must contain 2 numerals from the list {0, 1, 2, 3, 4, 5, 6, 7, 8, 9} and 2 letters from the list {a, A, b, B, c, C, d, D, e, E}. The first symbol must be a letter. Symbols may be repetitive. How many passwords can be generated meeting those conditions?
 - A. 100 000
 - B. 400 000
 - C. 600 000
 - D. 800 000
 - E. 1 000 000
- 26. Which of the following sets of functions is not qualified as overloaded function?
 - A. void fun(int, char *) void fun(char *, int)
 - B. void x(int, char) int *x(int, char)
 - C. int get(int)
 - int get(int, int)
 - D. void F(int *) void F(float *)
 - E. All of the above are overloaded functions

Answer Sheet

1.	А	В	С	D	E
2.	A	В	С	D	E
3.	A	В	С	D	E
4.	А	В	С	D	E
5.	A	В	С	D	E
6.	А	В	С	D	E
7.	A	В	С	D	E
8.	A	В	С	D	E
9.	A	В	С	D	E
10.	A	В	С	D	E
11.	А	В	С	D	E
12.	A	В	С	D	E
13.	A	В	С	D	E

14.	А	В	С	D	E
15.	A	В	С	D	E
16.	A	В	С	D	E
17.	A	В	С	D	E
18.	A	В	С	D	E
19.	A	В	С	D	E
20.	A	В	С	D	E
21.	A	В	С	D	E
22.	A	В	С	D	E
23.	A	В	С	D	E
24.	A	В	С	D	E
25.	А	В	С	D	E
26.	A	В	С	D	E

Student

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