# 19th International Microelectronics Olympiad

#### ADDITIONAL T E S T

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 \_\_\_\_\_

- 1. Which is the basic consequence of MOS transistor's degradation due to warm carriers?
  - A. The increase of threshold voltage
  - B. The decrease of threshold voltage
  - C. The increase of channel resistance
  - D. The decrease of channel resistance
  - E. The decrease of drain-package disruption voltage
- **2.** C capacitance is connected to the end of interconnect line with L length, line parameters are c [F/m], r [Ohm/m]. By what formula is the signal delay time in the line given?
  - A. 0.7rc
  - *B.* 0.7*Lr*(*C*+*c*)
  - C. 0.7Lr(C+Lc/2)
  - D. 0.7Lr(C+Lc)
  - *E.* 0.7*Lr*(*C*/2+*Lc*/2)
- 3. Denote by φ the set of all possible single stuck-at-0 and stuck-at-1 faults on input and output lines of logical V ("OR"), & ("AND") ^("NOT"). For any fault F ∈ φ, denote by T(F) the set of all input ("test") patterns detecting F. It is said for any two faults Fi, Fj ∈ φ that "fault Fi dominates fault Fj if:
  - A.  $T(Fi) \cap T(Fj) = \emptyset$
  - $B. \quad T(Fi) = T(Fj)$
  - C.  $T(Fi) \subseteq T(Fj)$
  - D.  $T(Fj) \subseteq T(Fi)$
  - E. The correct answer is missing
- **4.** Which function corresponds to the following polynomial  $y=1 \oplus x1 \oplus x1 \cdot x2 \oplus x3$ ?
  - A.  $y = \overline{x1} \cdot \overline{x3} + x2 \cdot \overline{x3} + x1 \cdot \overline{x2} \cdot x3$ B.  $y = \overline{x1} \cdot \overline{x3} + x2 \cdot \overline{x3} + x1 \cdot x3$ C.  $y = \overline{x1} \cdot \overline{x2} + x2 \cdot \overline{x3} + x1 \cdot x3$ D.  $y = x1 \cdot \overline{x2} \cdot x3 + x2 \cdot \overline{x3} + x1 \cdot \overline{x3}$ E. The correct answer is missing
- 5. What is the vibration, occurring due to supply voltage noise, called?
  - A. Simply vibration, does not have certain name
  - B. Deterministic
  - C. Non-deterministic
  - D. Random
  - E. Supply voltage vibration
- **6.** The volt-ampere characteristics of the semiconductor p-n junction is:
  - A. Linear
  - B. Highly nonlinear

- C. Direct current is smaller than reverse current
- D. Reverse current is larger than direct current
- E. Does not depend on temperature.
- **7.** How will the small signal amplification coefficient of an amplifier change if the channel width of M1 transistor is shared?



- A. It is shared, too
- B. It doubles
- C. It becomes a little less than half
- D. It increases by more than 2 times
- E. It becomes a little more than half
- **8.** Breakdown mechanisms of semiconductor p-n junction are:
  - A. Avalanche
  - B. Tunnel
  - C. Thermal
  - D. Electrical
  - E. All the answers are correct
- **9.** By ion doping method, the depth of p-n junction that is formed in semiconductor crystal volume, depends on:
  - A. Accelerated ion energy
  - B. Semiconductor crystallographic orientation
  - C. Accelerated ion type
  - D. Initial concentration of impurities in a crystal
  - E. All the answers are correct
- **10.** The depth of p-n junction that is formed by ion doping method, depends on:
  - A. Accelerated ion energy and type
  - B. Ion beam dose
  - C. Only accelerated ion type
  - D. Ion current density

#### E. Only crystal temperature

**11.** The function  $f(x) = \cos x$  is replaced by the interpolating polynomial L<sub>3</sub> by equidistant nodes k

(i.e. third order polynomial, what have the values  $y_k = \cos \frac{k}{n}b$  in the points  $x_k = \frac{k}{n}b$ , k = 0, 1, 2, 3) on the interval [0, b]. Find the value of b, such that the error does not exceed 10<sup>-3</sup>.

- A. 1,5
- *B.* 1,4
- C. 1,3
- D. 1,2
- *E.* 1,1

**12.** Which of the mentioned parameters is fixed for all cells of the given Standard Cell Library?

- A. Supply voltage
- B. Area
- C. Cell length
- D. Input capacitance of the cell
- E. Output capacitance of the cell
- **13.** During IC design, which is maintained constant?
  - A. Cell dimensions
  - B. Preparation technology
  - C. Interconnects width
  - D. The number of metal layers
  - E. Area
- **14.** Which of the following parameters is characterized by an electrical short or long connection lines difference?
  - A. Load capacitance
  - B. Signal power
  - C. Signal frequency
  - D. Interconnect width
  - E. A. and B.
- **15.** The code below is aimed to shift the values in the array data to the left, so that if original array is



After the code execution the array will contain the following:

6 8 1 15 2 1
--------------

There are two lines of code missing in this program line1 and line2. Which lines should be placed instead of line1 and line2 for the code to work? (n=6, which is the number of elements in data array)

//line1

```
for (int i = 0; i < n - 1; i++)</pre>
```

{

```
data[i] = data[i + 1];
```

}

```
//line2
```

#### А.

```
//line1
temp = data[0];
//line2
data[0] = temp;
```

## В.

//line1

```
temp = data[0];
//line2
```

data[n - 1] = temp;

## С.

```
//line1
temp = data[n - 1];
//line2
data[0] = temp;
```

## D.

//line1

```
temp = data[n - 1];
//line2
data[0] = temp;
```

## Е.

```
//line1
temp = data[n - 2];
//line2
```

data[n - 1] = temp;

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

# Additional Test Answer Sheet

Participant