

Innopolis University
Academic Year 2025/2026
Computer Architecture Course
Midterm Exam
ANSWERS
24th October 2025
Duration: 60 mins

Student Full Name:

Student Telegram:

Exam Room:

Started education late (due to Visa delay): NO / YES

Summary (for instructors fill)	
Question	Grade
Question 1	
Question 2	
Question 3	
Question 4	
Question 5	
Question 6	
Question 7	
Question 8	
Total (max. 15 points)	

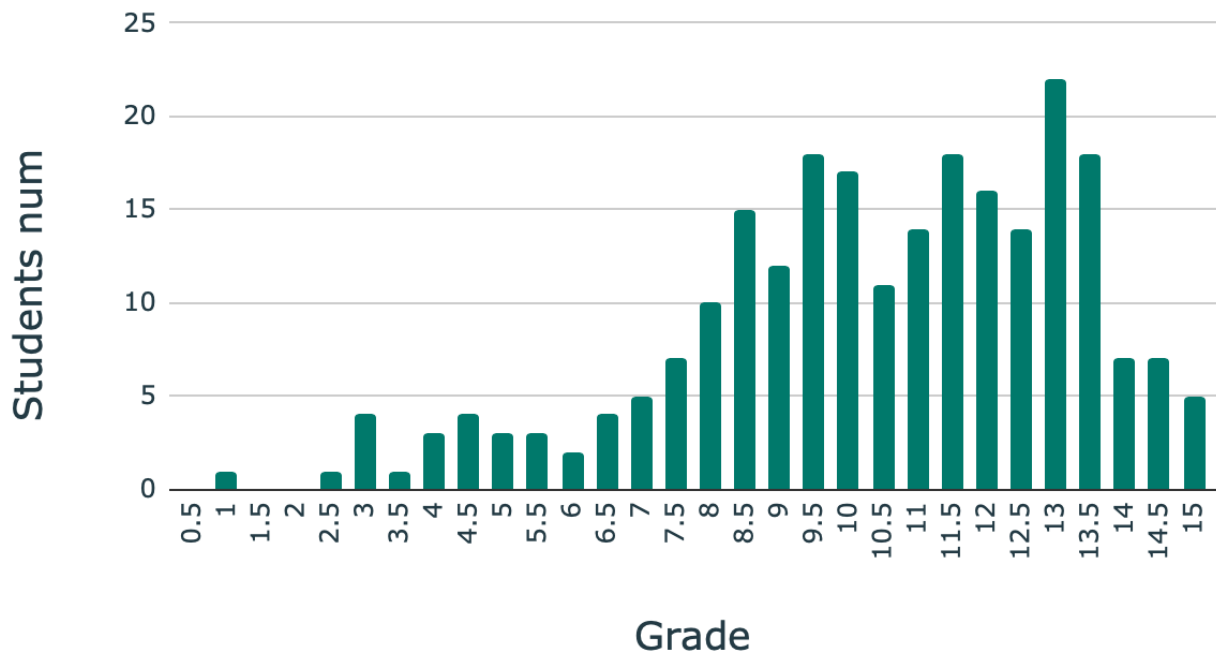
Please write clearly your name and your solutions. Write your name at every page.

What will not be understood will be considered wrong. All answers must be provided in English, everything written in Russian will be ignored.

This is a closed-book exam. You are not allowed to use any reference materials or electronic equipment, apart from this booklet and pens. You are not allowed to consult any person, otherwise you will be disqualified from this exam at the very first attempt.

Student Signature:

Grades Distribution



Question 1 (1 point). Choose non-volatile memory units of a computer (circle or underline correct options):

- 1) **USB stick - correct, but no penalty if not chosen**
- 2) System Memory
- 3) L1 and L2 Caches
- 4) **Solid-State Drive (SSD) – correct**
- 5) **Hardware Disk Drive (HDD) - correct**
- 6) None of the above

Grading notes:

(+0.5) – for any correct option chosen, but at most 1;

(-0.5) – for any incorrect option chosen, except option 6;

(-1) – for option 6.

Question 2 (1 point). Name the CPU component responsible for performing Instructions Fetch (IF) from memory.

Answer: Control Unit (CU)

(answer “registers” is also considered, due to a possible lecture slides misinterpretation)

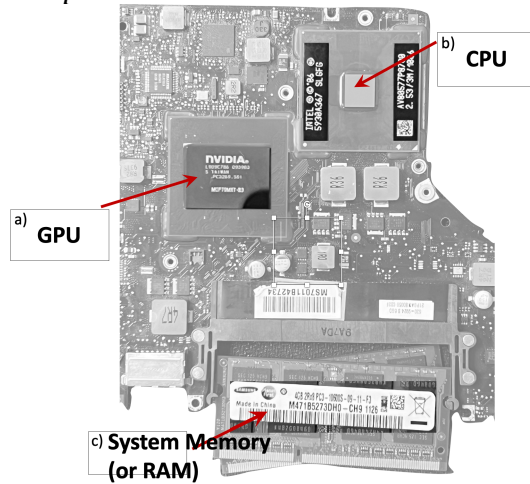
Grading notes:

(+1) – for a fully correct answer, otherwise 0.

Question 3 (2 points). The photo below depicts the fragment of a computer laptop hardware. Specify in the empty rectangles names of pointed components. What is the major difference between components “a” and “b”?

Answer:

Component names:



Some possible differences between “a” and “b” components:

- GPU has more cores than CPU;
- GPU has more ALUs than CPU;
- GPU supports SIMD parallelism model;
- GPU is used to process graphics, unlike CPU;
- Unlike CPU, GPU has a limited Instruction Set
- Other

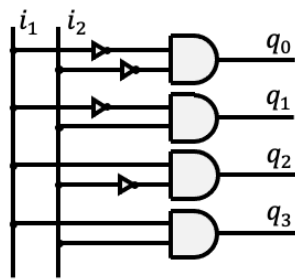
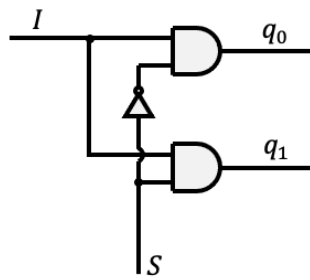
Grading notes:

(+0.5) – for every correctly named component in the diagram;

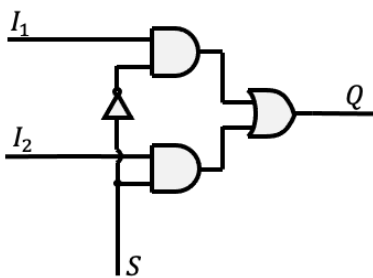
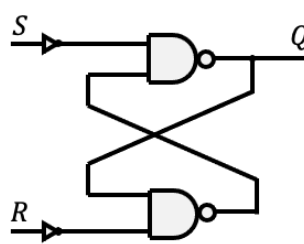
(+0.5) – for a correctly described difference between CPU and GPU

Question 4 (3 points). The diagram below depicts well-known logic circuits used in computer components. Do the following:

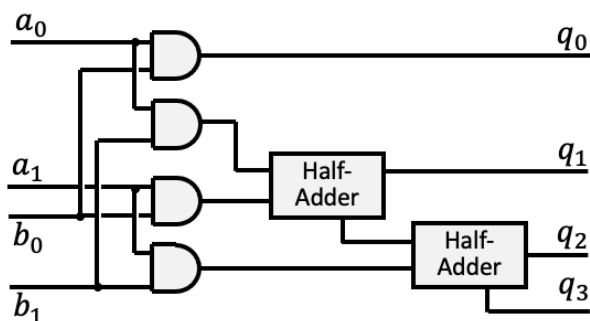
- 1) (1 point) For each circuit specify its corresponding name in an empty rectangle;
- 2) (2 points) For circuits “b”, “d”, “e”, “f” fill-in their truth tables.

a) **Decoder**b) **Demultiplexer**

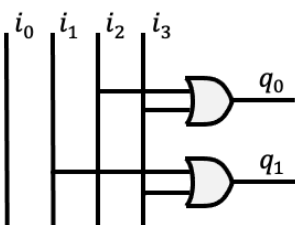
I	S	$Q = q_1 q_0$
0	0	00
0	1	00
1	0	01
1	1	10

c) **Multiplexer**d) **S/R Latch**

S	R	Q
0	0	Q^{prev}
0	1	0
1	0	1
1	1	Invalid

e) **Multiplicator**[Cases for $A > B$ only]

$A = a_1 a_0$	B	Q
01	00	0000
10	00	0000
10	01	0010
11	00	0000
11	01	0011
11	10	0110

f) **Encoder**

i_0	i_1	i_2	i_3	q_0	q_1
1	0	0	0	0	0
0	1	0	0	0	1
0	0	1	0	1	0
0	0	0	1	1	1

Grading notes:

(+0.2) – for each correctly specified circuit name, but at most 1 point in total;

(+0.5) – for each fully correctly filled truth table;

Question 5 (2 points). What is the key idea of Amdahl's law? Plot Amdahl's law for a program with 90% of parallelizable instructions.

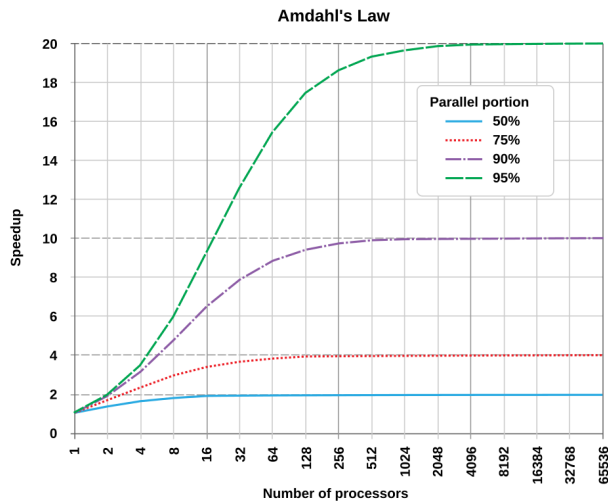
Answer:

One of possible formulations for Amdahl's law idea (equation is not needed):

The increase of the number of cores speeds-up the execution of a program proportionally to the fraction of parallelizable instructions.

Amdahl's law plot for a program with 90% of parallelizable instructions:

Purple line among the ones below:



Grading notes:

(+1) – Correctly described idea of Amdahl's law;

(+0.5) – Correctly labeled axes;

(+0.5) – Correct plot line (with precise numeric values), but a totally correct equation was also considered.

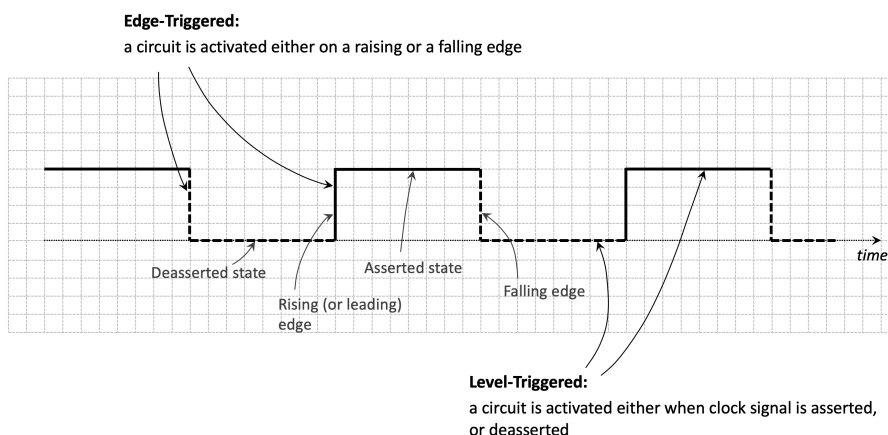
Question 6 (2 points). Answer the following questions regarding a CPU clock generator:

a) (0.5 points) What is the main purpose of a CPU clock?

A possible brief answer: To synchronize inputs/instructions execution by CPU.

b) (0.5 points) Draw a clock wave and name its key parts by using standard terminology:

Edge-Triggered and Level-Triggered Timing Methodologies



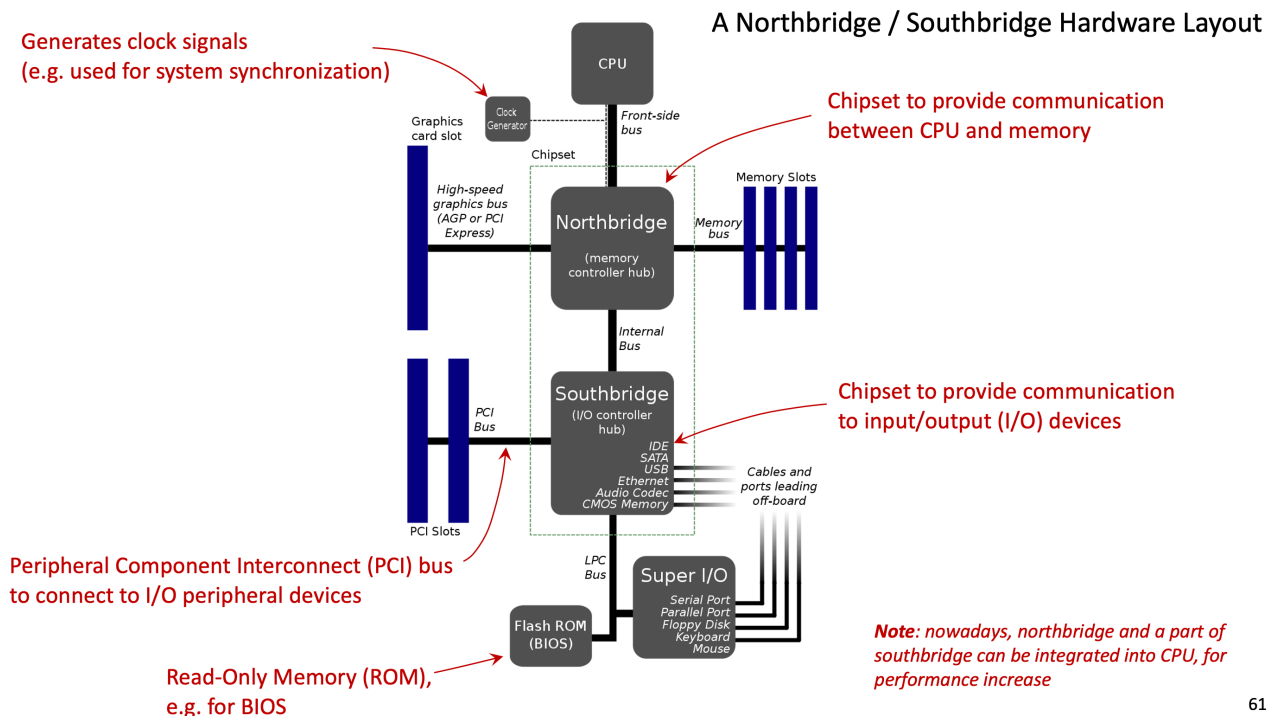
- c) (0.5 points) What is the relation between a CPU speed and its clock wave period?
A possible brief answer: Higher the CPU clock period, slower the execution speed of CPU
- d) (0.5 points) What is the difference between level-triggered and edge-triggered clock methodology? *Brief answer: See note on the diagram above.*

Grading notes:

(+0.5) – for every fully correctly answered sub-question

Question 7 (2 points). The diagram below represents a northbridge/southbridge computer layout. Fill-in the missing component names into empty rectangles.

Answer:



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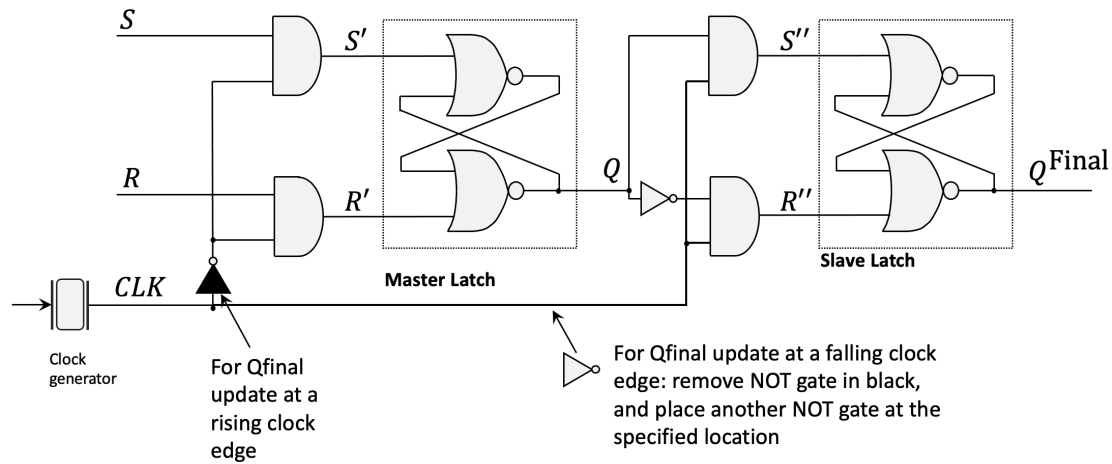
Grading notes:

(+0.4) – for every correctly specified option (CPU, Clock, Memory slots, Northbridge and Southbridge chipsets)

Question 8 (2 points). Draw the circuit of a flip-flop, which updates its output value at the rising clock edge. Describe the necessary change to make this circuit update its output value at the falling clock edge instead.

Answer:

Student Name:



*Description of changes to make output value to be updated at a falling clock edge:
See instructions provided in the diagram above.*

Grading notes:

- (+0.5) – correctly specified master and slave latches;
- (+0.5) – correctly connected clock signal;
- (+0.5) – correctly placed NOT gates;
- (+0.5) – for a correct transformation description into updating Q^{Final} at a falling edge.

**This is the end of the student book
Draft Paper**