

SCHOOL OF SCIENCE

Exam Title: **INTRODUCTION TO COMPUTER SYSTEMS + RESIT**

SPRING 2017

EXAMINATION FOR THE DEGREE PROGRAMMES IN

Computing, (All options) January 2016, September 2016

Exam Code: 20172AIAI015AWN

TIME ALLOWED: **2 HOURS**

MATERIALS PERMITTED: **Calculator**

MATERIALS PROVIDED:

INSTRUCTIONS:

1. Answer **THREE** out of the four questions. You must indicate on the cover of your answer book the **THREE** questions that you want the examiner to mark. If you fail to indicate your choice of questions, the first three questions will be marked in the order in which they appear in your answer book.
2. Start each question on a new page.
3. Be tidy: marks may be deducted for untidy work.

Question 1

- i) Explain, with examples, the difference between computer organisation and computer architecture?

(20 marks)

- ii) Explain the differences between CISC and RISC instruction sets? Give examples.

(25 Marks)

- iii) How often does a Solid State Drive need defragmentation and why?

(10 Marks)

- iv) In the context of data storage devices:

- a) Briefly define seek time, latency, and transfer time.
b) Given the parameters in table below, what are the values of seek time, latency, and transfer time?

rotation speed	7,200 rev/min
arm movement time to an adjacent track	0.02 msec
Number of tracks/surface	1,000
Number of sectors/track	64

(25 Marks)

- v) Convert the following unsigned binary number 1011001 into:

- a. Base 6
b. Octal
c. Decimal
d. Hexadecimal

(20 Marks)

Question 2

- i) The addresses and contents of a memory map () is shown below. Evaluate the following expressions:

- a) [6] b) [5 + 4] c) [3 x [5]] d) [[[4]]] e) [[4] + [13]]

(Note that [N] is the contents of the memory location whose address is N).

Address	Content	Address	Content
0	14	8	61
1	10	9	51
2	6	10	3
3	6	11	22
4	12	12	7
5	4	13	1
6	11	14	25
7	0	15	13

(20 Marks)

- ii) Explain why the maximum memory size of a 32-bit architecture is 4 GB.

(10 Marks)

- iii) Assume $x=5$, $y=2$, and $z=5$. Evaluate the value of each of the following Boolean expressions (show the evaluation details).

- a) $(x > 3) \text{ OR } (y < 5) \text{ OR } (z \leq x)$
 b) $(x+y \geq z) \text{ AND } [(x > 6) \text{ OR } (z \leq 5)]$
 c) $[\text{NOT}(z > 10)] \text{ AND } [(z=7) \text{ OR } (y < 2)]$

(20 Marks)

- iv) Parity bits are used to check if data has been corrupted during transmission. An even parity generator circuit outputs 1 if the input data contains an odd number of 1s. Otherwise, its output is 0. By concatenating the parity bit to the input data, the total number of ones will always be even. Build an even parity generator circuit for 3-bit input using the sum-of-products algorithm. You may only use AND, OR and NOT gates

(35 Marks)

- v) Draw and briefly explain a simple 2-to-4 memory address decoder circuit to select one memory address out of four available addresses?

(15 Marks)

Question 3

- i) Briefly explain the reasons behind the following:
- a. Using GPUs is highly recommended for high-throughput image processing.
 - b. Static RAM is faster than Dynamic RAM.
 - c. Accessing data on L3 cache is slower than L1.
 - d. Dropping an external HDD leads to damaging it (most likely) but this is not the case for SSDs.

(24 Marks)

- ii) Let the average access time of memory be 20 nsec, and the average access time for cache memory be 7 nsec.
- a) What is the overall average access time if the cache hit rate is 80%?
 - b) What is the cache hit rate that make the average access time 10 nsec?

(20 Marks)

- iii) Convert the following decimal numbers into binary and perform the operations in 8-bit 2's complement arithmetic. Indicate if an overflow has occurred.
- a. $31 - 9$
 - b. $-120 - 10$
 - c. $100 + 30$

(16 Marks)

- iv) Convert the decimal number -129.3214 into the IEEE standard 32-bit format for floating-point numbers.

(20 Marks)

- v) Translate the following algorithm into assembly language using the instructions of the Little Man Computer (LMC)

```
Input mark
IF mark >= 40 THEN
    success =1
ELSE
    success =0
End
Output success
```

(20 Marks)

Question 4

- i) Assume you have a 100x100 pixels RGB coloured image where each pixel has three colour components (red, green, and blue), and the range of each colour is [0 255]:

- a) How this image is represented internally as zeroes and ones?
- b) How many bytes does it take to store this image?

(20 Marks)

- ii) Briefly explain how different CPU registers are used by the control unit to run one instruction cycle of a programme.

(15 Marks)

- iii) In computer networks, briefly describe the different types of communications media to transfer signals from senders to receivers?

(20 Marks)

- iv) Briefly explain the following:

- a) IP v6
- b) SDRAM
- c) DDR3
- d) SRAM
- e) IR register

(25 Marks)

- v) In the context of cloud computing, what is meant by Software as a Service (SaaS) and Platform as a Service (PaaS)? Give examples

(20 Marks)

End