

**SCHOOL OF SCIENCE**

Exam Title : **INTRODUCTION TO COMPUTER SYSTEMS + RE-SIT**

Spring 2016

EXAMINATION FOR THE DEGREE PROGRAMMES IN

Computing, (All options) January 2016, September 2015

Exam Code: 20162AIAI118AWN

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 the differences between CISC and RISC instruction sets? Give examples  
(20 Marks)
- ii) Briefly explain the reasons behind the following:
- a. The maximum memory size of a 32-bit computer architecture is 4 GB
  - b. Dropping an external HDD leads to damaging it (most likely) but this is not the case for SSDs.
  - c. Software and music albums are often distributed on CDs/DVDs.
  - d. Accessing data on L1 cache is faster than L3.
  - e. Machine code written for a Raspberry Pi does not work on a PC
- (25 Marks)
- iii) What types of problems are more efficient to be processed using a GPU rather than a CPU? Give an example  
(10 Marks)
- iv) Convert the following unsigned binary number 1011001 into:
- a. Octal
  - b. Hexadecimal
  - c. Decimal
  - d. Base 6
- (20 Marks)
- v) Perform the following decimal operations in 8-bit 2's complement arithmetic. Indicate if an overflow has occurred.
- a. 25 - 10
  - b. 127 - 126
  - c. -127 - 2
  - d. 64 + 65
- (25 Marks)

**Question 2**

- i) Assume  $x=3$ ,  $y=1$ , 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)

- ii) In the context of representing floating-point numbers in binary format:

- e. Briefly explain what is meant by 'range' and 'precision'. Give examples
- f. Convert the decimal number -72.125 into the IEEE standard 32-bit format for floating-point numbers.

(25 Marks)

- iii) Based on the circuit given in Figure 1, answer the following two questions:

- a. Tabulate the values of the variables X, Y and Z in the circuit for all possible values for the inputs A, B and C.
- b. Work out the Boolean expression of the output Z, in terms of the inputs A, B, and C.

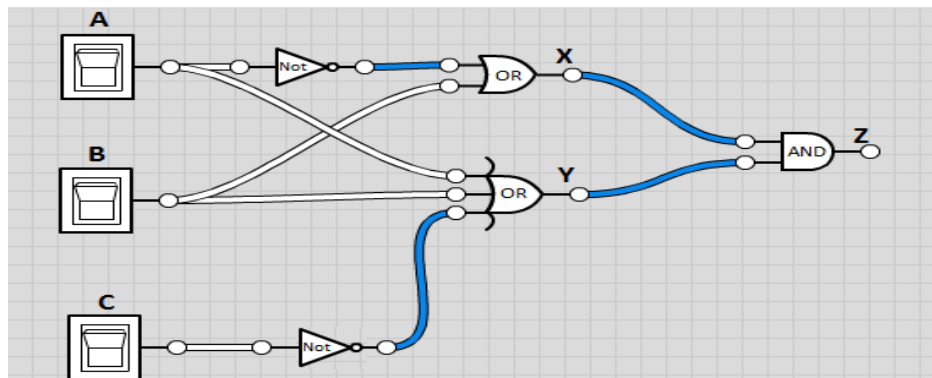


Figure 1

(20 Marks)

- iv) A majority-rules circuit has three inputs and one output. The value of its output is 1 if and only if two or more of its inputs are 1; otherwise, the output is 0. Design a majority-rules circuit using the sum-of-products algorithm. You may only use AND, OR and NOT gates

(35 Marks)

**Question 3**

i) What are the characteristics of an ideal memory?

(15 Marks)

ii) Briefly explain the concept of sampling rate and bit depth in the context of analogy to digital conversion (give examples)?

(20 Marks)

iii) How many bytes does it take to store:

- a. A 3-minute and 12-second song using 40,000 samples per second rate and a bit depth of 16.
- b. "COMPUTER SYSTEMS" as a string encoded using the standard ASCII code

(20 Marks)

iv) Let the average access time of memory be 20 nsec, and the average access time for cache memory be 8 nsec.

- a) What is the overall average access time if the cache hit rate is 80%?
- b) What would the cache hit rate have to be to make the average access time 10 nsec?

(20 Marks)

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

Note: using the instructions of the 68K instruction set is also acceptable.

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

(25 Marks)

**Question 4**

- i) Draw and explain a simple 2-to-4 memory address decoder circuit to select one memory address out of four available addresses.  
(20 Marks)
- ii) What functions does a DNS server offer?  
(10 Marks)
- iii) Briefly describe the different types of communications media in computer networks.  
(20 Marks)
- iv) Briefly explain the following:  
a. IR Register  
b. PC register  
c. SDRAM  
d. DDR2  
e. SRAM  
f. HTML  
g. IP Address  
(35 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.  
(15 Marks)

**End**