



Exam Title: **INTRODUCTION TO COMPUTER SYSTEMS**

EXAMINATION FOR THE DEGREE PROGRAMMES IN

Computing, (All options) January 2015

Exam Code: 20152AIAI115AWN

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) Briefly explain the three main characteristics of the Von Neumann computer architecture?
(15 marks)
- ii) Explain the differences between CISC and RISC instruction sets?
(20 Marks)
- iii) What is the minimum number of bits needed to represent the following:
a) $(512)_{10}$
b) $(320)_{10}$
c) $(3DE)_{16}$
d) $(67)_8$
(15 marks)
- iv) Determine the decimal value of the binary number 10110010 assuming it is represented as:
a) An unsigned binary integer
b) A signed two's complement integer
c) A sign and magnitude binary integer
(15 Marks)
- v) Perform the following operations
d) $72 - 102$ in a sign and magnitude binary integer
a) $65 + 99$ in unsigned 8-bit integer
b) $39 - 78$ in a signed two's complement 8-bit integer
c) $F9 + 7B$ in hexadecimal
(20 marks)
- vi) Convert the decimal number 229 into:
a) Base 6
b) Octal
c) Hexadecimal
(15 marks)

Question 2

- i) Consider the IEEE standard for floating-point numbers.
- a) Explain how the number of bits used for the mantissa and the exponent relates to the range and the precision of floating-point numbers.
 - b) Convert the decimal number -63.3214 into the IEEE standard 32-bit format for floating-point numbers.

(25 marks)

- ii) 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 it?

(15 Marks)

- vii) Assume $x=5$, $y=-2$, and $z=3$. Evaluate the value of each of the following Boolean expressions (show details).

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

(15 Marks)

- i) 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

(30 Marks)

- viii) Draw and 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) What are the characteristics of an ideal memory?

(10 Marks)

ii) What would be the maximum memory size that can be addressed by a 32-bit computer system?

(10 Marks)

iii) What are the functions of a control unit in a CPU?

(15 Marks)

iv) Compare direct access storage devices with sequential access storage devices (give examples)?

(10 Marks)

v) Briefly explain the concept of 'Sampling rate' and 'bit depth' in the context of analogy to digital conversion. Give examples

(15 Marks)

vi) 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)

vii) Translate the following algorithm into assembly language using the 68K instruction set.

IF $X < 30$ THEN

$Y = 4 * X + 5$

ELSE

$Y = X + 20$

(20 Marks)

Question 4

i) In the context of memory sub-systems, what is the Principle of Locality? Explain how it has been used to improve the overall performance of computer systems. (15 Marks)

ii) Briefly describe the different types of communications media? (20 Marks)

iii) Briefly explain the following:

- a) SDRAM
- b) DRAM
- c) DDR2
- d) SRAM
- e) PC register
- f) IR register

(30 Marks)

iv) 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)

v) What are the stages of a fetch instruction cycle? (20 Marks)

End