UNIVERSITY OF DUBLIN
TRINITY COLLEGE

Faculty of Engineering, Mathematics and Science

School of Computer Science and Statistics

B.A.I. in Engineering
Junior Sophister

Trinity Term 2013

Microprocessor Systems I (CS3D1)

Thursday 9th May 2013 **RDS Main Hall** **09:30-11:30**

Dr John Waldron

Instructions to Candidates:
You **MUST** Answer
Question 1 from **Section A** (30 marks) and
TWO out of **THREE Questions** from **Section B** (35 marks each)

Where you are asked to write an assembly language program, you must provide an adequate explanation of your program, for example, in the form of pseudo-code comments.

Materials permitted for this examination:
To be accompanied by an **ARM Instruction Set and Addressing Mode Summary** booklet

Non-programmable calculators are permitted for this examination
Please indicate the make and model of your calculator
on each answer book used

SECTION A

30 Marks

You MUST answer Question 1 from this section

Suggested time allocation: 40 minutes

Question 1.

(a) What is the function of the S bit in a machine code instruction?

[2 marks]

(b) Give an assembly language example to illustrate the use of the S bit.

[3 marks]

(c) Why do computers use the two's complement representation for signed numbers?

[6 marks]

(d) Show in ARM assembly language how to invert bits **1** and **3** of the value in **r1**, leaving the other bits unchanged.

[6 marks]

(e) Formulate a single ARM assembly language instruction to pop **r1**, **r2**, **r3** and **r5** off a full descending stack with **r13** (or **sp**) as the stack pointer

[6 marks]

(f) Formulate a single ARM assembly language instruction other than MUL to multiply **r3** by **31** and store the result in **r7**.

[7 marks]

SECTION B

70 marks

You MUST answer TWO out of THREE questions from this Section
All questions are worth 35 marks

(Suggested time allocation: 40 minutes per question)

Question 2.

(a) Design and write an ARM Assembly Language program that will compute **a/b** by repeatedly subtracting **b** from **a**. Assume that **a** is stored in **r2** and **b** is stored in **r3** and that both **a** and **b** are unsigned values. Your program should store the quotient in **r0** and the remainder in **r1**.

[15 marks]

(b) Design and write an ARM Assembly Language program that will reverse the bits in a register so that the register containing **d31 d30 .... d1 d0** now contains **d0 d1 ..... d30 d31**.

[20 marks]

Question 3.

(a) Design and write an ARM Assembly Language program that will count the number of words in an ASCII NULL-terminated string. Assume that register **r1** contains the address of the start of the string. Store the number of words in **r0**. Assume that all words are separated by a single ASCII space character **0x20** and that the only other characters in the string are alphabetic characters.

[15 marks]

(b) Design and write an ARM Assembly Language program that will calculate the parity bit for a 15-bit value stored in **r0**. The program should then store the computed parity bit in bit **15** of **r0**. Use odd parity.

[20 marks]

Question 4.

(a) Design and write an ARM Assembly Language program that will compute the surface area of a rectangular cuboid, given its three dimensions (length, depth, height).

[15 marks]

(b) Design and write an ARM Assembly Language program that will reverse a string stored in memory. The reversed string should be stored as a new string and should not overwrite the original string. For example, given the string **assembly**, your program should create the new string **ylbmessa**

[20 marks]