UNIVERSITY OF HERTFORDSHIRE **CS1 / CSP2 / CD1**

Session 1998/9

Bachelor of Science Degree with Honours in Computer Science, Sandwich and Part-time
Higher National Diploma in Computing

1COM0008 SYSTEMS AND NETWORKS 1

Semester B Duration: 3 hours

The following are provided for this exam:

ONE Answer Book

A Multi-choice Mark sheet is provided to be used for Section A Question 1.

Instructions to Candidates:
Answer BOTH of the questions in SECTION A, which consists of TWO questions.
Answer THREE questions from SECTION B, which consists of FIVE questions.
Each question counts for 20 marks.
Calculators are NOT allowed.

This paper consists of SEVEN questions on NINE pages

Section A.

Question A.1.

Your answers to this question must be coded on the Optical Mark Sheet provided.

Do **NOT** write or code anything in the header information on the sheet except:

In the Subject box **print** "**S&N1 – M**".

Then, under Candidate number, **print** and **mark code** your **Anonymity number**.

You may only choose **ONE answer** for each question.

Do **NOT** guess, you might **lose a mark**.

1) Which hexadecimal (hex) number is the correct 8 bit 2s Complement Representation of -72_{10}? [2 marks]

A) B8 B) 48 C) F2 D) 72 E) None of these

2) Which hex number is the correct answer to the addition of the two 8 bit hex numbers 9A and DC [2 marks]

A) 9C B) 46 C) 98 D) 76 E) None of these

3) After the addition in question 2 above which of the following represents the settings of the flags, CVNZ: [2 marks]

A) 0000 B) 1010 C) 1100 D) 0110 E) 1011

4) When interpreted as an 8 bit unsigned number what denary value does the hex number D6 represent? [2 marks]

A) 136 B) –42 C) 78 D) 214 E) None of these

5) When interpreted as an 8 bit 2s Complement number what denary value does the hex number CB represent? [2 marks]

A) 131 B) -53 C) 203 D) -85 E) 53

6) Which hex number is the correct representation of 83.78125_{10}? [2 marks]

A) 53.C1 B) AD.D C) AD.D1 D) 53.C8 E) None of these

7) Which is the correct IEEE 754 normalisation for the hex number 2C7.98? [2 marks]

A) $1.01100011110011 \times 2^{10}$

B) $0.101100011110011 \times 2^{10}$

C) $10.1100011110011 \times 2^{2}$

D) $1.01100011110011 \times 2^{9}$

E) $0.101100011110011 \times 2^{9}$

8) Which hex number shows –7 in Excess 127 form? [2 marks]

A) 78 B) F9 C) 77 D) 79 E) None of these

The Op codes and mnemonics for The Little Man Computer, LMC, are:

1nn – LDA nn	2nn – STA nn	3nn – ADD nn	4nn – SUB nn
5xx – IN	6xx – OUT	7xx – HLT	
800 – SKN	801 – SKZ	802 – SKP	9nn – JMP nn

9) Given the following starting values of the memory locations, the accumulator and the PC:

Location	**30**	**31**	**97**	**98**	**Accumulator**	**PC**
Starting value	398	297	345	450	350	30

What are their contents after the execution of the next two instructions? [2 marks]

	Location	30	31	97	98	Accumulator	PC
A)		398	297	345	450	800	30
B)		398	297	345	450	-100	32
C)		398	297	200	450	450	32
D)		398	297	800	450	800	32
E)		398	297	-100	450	-100	31

10) What are the micro steps (Register Transfer Language) for the Fetch and Execute of the instruction SKP on the LMC [2 marks]

A) PC→MAR, MDR→IR, IF N==0 THEN PC+1→PC, PC+1→PC, ELSE PC+1→PC, END IF

B) PC→MAR, MDR→IR, PC+1→PC, IF N==0 THEN PC+1→PC, END IF

C) PC→MAR, MDR→IR, IF N ⌉=1 ∧ Z == 0 THEN PC+2→PC ELSE PC+1→PC END IF

D) PC→MAR, MDR→IR, PC+1→PC, IF Z==0 THEN PC+1→PC END IF

E) MAR→MDR, MDR→PC, IF Z==0 THEN PC+1→PC END IF

Question A.2.

1) Name the individual parts of the following command line.

   sort -m file1 file2 > sortfile &

   (Note: you are not expected to describe what the command line does) [3 marks]

2) List four pieces of data stored in a Process Control Block (PCB) by the operating system and explain the purpose of the PCB. [3 marks]

3) When the dispatcher runs it performs a context switch. What is the meaning of the term context switch? [2 marks]

4) When considering processes and resources in a computer system, explain what is meant by the term deadlock. Give a diagram showing a simple example. [4 marks]

5) State the main reason why the work of the assembler is broken down into two passes.

   [2 marks]

6) What is a protocol? What is the benefit of designing systems so that they use standard protocols? What are some of the disadvantages? [6 marks]

Section B

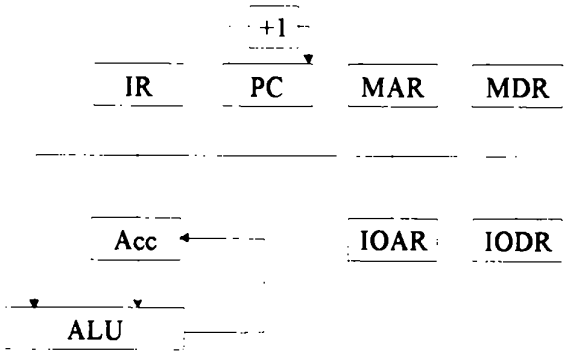
Question B.1.

a) Briefly describe the components of the basic von Neumann computer and say how the LMC relates to it [4 marks]

b) For the input, 8, 15, 12 and 0, trace the following LMC program showing the location of the instruction obeyed and the contents of the accumulator and any memory locations that have been changed by it. Also give the final output of the program. [6 marks]

Location	Code	Location	Code	Location	Code
0	Lda 99	5	Jmp 9	10	Out
1	Sta 98	6	Add 98	11	Hlt
2	In	7	Sta 98	98	Dat 0
3	SKZ	8	Jmp 2	99	Dat 0
4	Jmp 6	9	Lda 98		

c) In the diagram that follows, describe the functions of each of the registers shown, IR, PC, MAR, MDR and Acc [5 marks]



d) If a memory bus has 16 address lines and 16 data lines say

(i) how many memory locations can be addressed [1 mark]

(ii) how many bytes are accessed in one memory cycle [1 mark]

e) Name the other component of a memory bus and give an example of two of its lines? [3 marks]

Question B.2.

a) A disc has 4 platters, 512 cylinders, 768 sectors per track and there are 512 bytes per sector.

(i) Briefly describe the terms *platter*, *cylinder*, *track* and *sector* [4 marks]

(ii) What is its capacity in Megabytes, Mb? [3 marks]

b) The disc rotates at 7200 rpm and uses a 32 sector cluster. If its average seek time is 9ms what is the average time to read a cluster? [4 marks]

c) A video card is defined in terms of its *resolution* and the number of colours it can display. What is meant by a screen's resolution? [2 marks]

d) An Addressing Mode may be defined as the way in which the data for an instruction is retrieved (or stored). Given the contents of memory and the index register, X, that follow, what will the Accumulator contain as a result of each these instructions:

(i) LDA 80 ; absolute

(ii) LDA *70 ; indirect

(iii) LDA *@60 ; indirect then indexed

(iv) LDA @*60 ; indexed then indirect [4 marks]

Location	**50**	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**X**
Content	90	85	80	70	75	65	60	55	50	5

e) Briefly describe the steps that occur before and after an ISR is processed [3 marks]

Question B.3.

a)

(i) State and explain two disadvantages of using a Graphical User Interface (GUI) rather than a Command Line Interface (CLI). [4 marks]

(ii) Give an example of a suitable target user group for the CLI type of interface, stating why it would be suitable. [2 marks]

b) The Shortest Job First (SJF) algorithm for process scheduling is not usually implemented in its raw form, due to the problem of 'starvation' or 'indefinite postponement'.

(i) Define starvation. [2 marks]

(ii) Demonstrate how starvation can occur when using the SJF algorithm. [2 marks]

(iii) Give two different amendments to the SJF algorithm that can prevent starvation. [4 marks]

c) This question concerns a file which is stored non-contiguously on a disk. The file has five blocks at present; blocks 14, 70, 61, 82 and 10 on disk. A linked file allocation system is in use.

(i) Draw a diagram of the blocks of this file on disk to show how the pointer system works.

[4 marks]

(ii) What steps will be taken when this file grows larger than its currently allocated space?

[2 marks]

Question B.4.

a) State the main functions of the Lexical analysis (or scanning) and syntax analysis (or parsing) phases of a compiler: [2 marks]

b) Produce syntax (or railroad) diagrams for the BNF rules for :

(i) statement

(ii) while-statement

(iii) simple-expression [5 marks]

BNF productions for use in Question 5 (b)

<statement> → *<assignment-statement>* | *<compound-statement>* | *<while-statement>*
<assignment-statement> → *<variable>* := *<simple-expression>*
<compound-statement> → begin *<statement>* { ; *<statement>* } end
<while-statement>→ while *<condition>* do *<statement>*
<condition> → *<simple-expression>* { *<relational-operator>* *<simple-expression>*}
<simple-expression> → *<term>* { *<add-operator>* *<term>* }
<relational-operator> → = | > | < | ≠
<term> → *<unsigned-constant>* | *<variable>*
<add-operator> → + | -

c) How does an interpreter differ from a compiler? What are the advantages of compiling programs rather than interpreting them? [4 marks]

d) Translate the following LMC assembly language program. Show both the symbol table and the LMC machine code produced. The LMC operations table is given below for use in the translation.

[9 marks]

```
Label      Op Code  Operand      / Comment
/ Program to perform division. It outputs the quotient first and
/ then the remainder. It works by repetitive subtraction.
/ Example:  for inputs 10 and 2, the outputs will be 5 and 0.
           INP
           STA      FIRST
           INP
           STA      SECOND
REPEAT:    LDA      FIRST
           SUB      SECOND
           SKP                   / Skip on positive, including zero
           JMP      DONE
           STA      FIRST
           LDA      COUNT
           ADD      ONE
           STA      COUNT
           JMP      REPEAT
DONE:      LDA      COUNT
           OUT
           LDA      FIRST
           OUT
           HLT                   / or COB Coffee break
ONE:       DAT      1
COUNT:     DAT      0
FIRST:     DAT      0
SECOND:    DAT      0
```

LMC Operations Table

Mnemonic	Op Code	No. of Operands
LDA	1	1
STA	2	1
ADD	3	1
SUB	4	1
INP	5	0
OUT	6	0
HLT	7	0
SOC*	8	1
JMP	9	1

*You will know SOC, Skip On Condition, as SKN, 800, SKZ, 801, and SKP, 802.

Question B.5.

a) Explain what is meant by the layering of communication protocols. What is the purpose of a protocol header? To which layers is this header visible? [5 marks]

b) Here are the rules of operation for two sides of a transport layer protocol. This transport protocol is intended to support Remote Procedure Call. The network layer connection used may lose, re-order or duplicate packets, but does not corrupt them:

Sender:

```
        txcount := 0
        get first packet to send
TX:     place txcount in packet header
        send packet
        wait for ack
        if NOT(count in ack.header = txcount) then go to TX
        txcount := txcount + 1
        get next packet to send
        go to TX
```

Receiver:

```
        rxcount := 0
RX:     wait for next packet
        place rxcount in ack.header
        send ack
        if NOT (count in packet.header = rxcount) then go to RX
        accept packet
        rxcount := rxcount + 1
        go to RX
```

(i) Design a protocol header for this protocol. Explain your design. [4 marks]

(ii) Sometimes this protocol does not work. Explain carefully one scenario where the protocol goes seriously wrong. [3 marks]

(iii) Suggest changes to the rules of operation which would make the protocol work correctly in this case, and give your reasoning.. [6 marks]

(iv) Is the network being used a virtual circuit or a datagram network? Explain why you think this. [2 marks]