THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME: LEVEL 04
DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
FINAL EXAMINATION – 2011/2012
CSU2178: DIGITAL COMPUTER FUNDAMENTALS
DURATION: **TWO HOURS (2 HOURS)**

Date: 06th December 2012 **Time: 9.30am - 11.30am**

Answer **FOUR** Questions **ONLY.**

Q1.

a) Briefly describe the following.

i. Two's complement
ii. Seven segment display
iii. The von-Neumann computer model
iv. Unicode character set

b) Convert the following Decimal numbers into **Binary**, **Octal**, and **Hexadecimal**.

i. 178_{10}
ii. 32_{10}

c) Use **two's complement addition** to perform the following calculations.

i. $89_{10} + 28_{10}$
ii. $89_{10} - 28_{10}$
iii. $-89_{10} + 28_{10}$
iv. $-89_{10} - 28_{10}$

d) Convert the following **hexadecimal** numbers into **binary**.

i. $5FB2_H$
ii. $F089_H$

e) Draw the truth table of a **full adder circuit** and implement it using basic logic gates.

Q2.

a) Describe **AND, OR, NOT** operations with use of **truth tables.**

b) Implement the following gates using **two-input NAND** gates.

i. NOT
ii. OR
iii. NOR
iv. XOR

c) Briefly explain the following.

i. Multiplexer
ii. Counter
iii. Register
iv. 8 to 3 encoder.

d)

i. Draw the block diagram and truth table for a **4 to 1 Multiplexer.**
ii. Implement the 4 to 1 multiplexer using basic logic gates.
iii. Implement the **16 to 1 Multiplexer** using **4 to 1 Multiplexers** only.

Q3.

a) Prove the following using **Boolean algebra**.

i. $(\overline{A}+B)(A+B+D)\overline{D}=B\overline{D}$

ii. $ABC+A\overline{B}C+AB\overline{C}=A(B+C)$

iii. $A(B+\overline{C})+B(C+\overline{A})+C(A+\overline{B})=A+B+C$

iv. $(A+B)(A+\overline{B})(\overline{A}+C)=AC$

v. $(A+B+C)(A+\overline{B}+C)(A+B+\overline{C})(A+\overline{B}+\overline{C})=A$

b) Find the minimal logic expression for the following truth table using the **K-MAP** method. Design a circuit to implement this truth table using **3-input** NAND gates only.

A	B	C	D	F (output)
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	1
0	1	1	0	X
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

c) A **three bit** binary number is represented as $A_2A_1A_0$, where **A2, A_1, A_0** represent the individual bit. A_0 = **LSB** (Least Significant Bit) and A_2 = **MSB** (Most Significant Bit) Design a logic circuit that will produce a high output (1) when the input **binary value** is **greater than 010** and low output (0) when the input value is **less than 100**.

a) Write short notes for each of the following.

i. Direct memory access.
ii. Data path.
iii. Disk files system.
iv. System bus model.

b) **"PORTs can be used to communicate with the computer."** Do you agree with this statement? Justify your answer.

c) What is the **difference** between **CMOS** and **TTL** IC types?

d) What is **fetch-execute cycle**? Briefly explain.

e) What are the **advantages** and **disadvantages** of the **Assembly Language**?

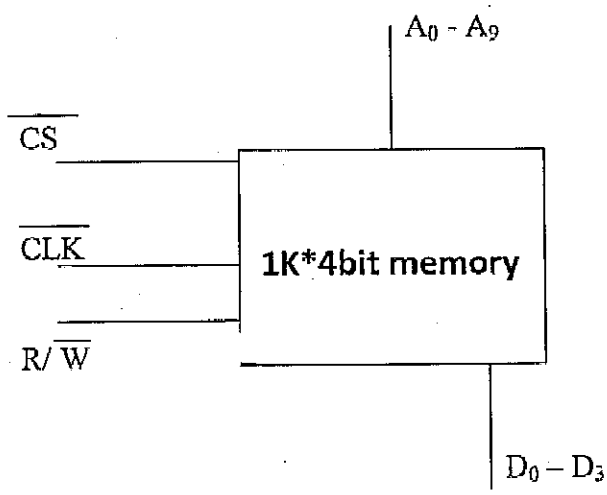
a) Explain the need for a **Memory Hierarchy** in a computer system.

b) Briefly explain how **Cache Memory** could be used to improve the performance of a computer system.

c) Describe the **advantages** of **SRAM** and **DRAM.**

d) What is meant by the **Word Length** of a processor?

e) Assume that you are given **FOUR 1K*4bit** memory chips and other necessary digital components (see Figure Q5.e). Using these:



(Figure Q5.e)

i. Construct 1K*16 bits memory.
ii. Construct 4K*4 bits memory.
iii. Construct 2K*8 bits memory.

Q6.

a) Describe **Combinational circuits** and **Sequential circuits**. Use a block diagram if necessary.

b) What is the importance of a **Clock** in **Sequential Circuits**?

c) Explain the function of a **JK flip-flop, T flip flop** and **D flip flop** using truth tables and block diagrams.

d) Construct a 4 bit shift register using **D flip-flop** as the basic building block. (draw the b diagram)

e) Explain the function of the 4-bit shift register constructed in above (Q6 – f)