The Open University of Sri Lanka

B.Sc. Degree Program: Level 04

Final Examination 2008/2009

CSU 2178-Digital Computer Fundamentals

Duration: **Two and a Half Hours**

Date: 10. 07. 2009 Time:1.30 pm – 4.00 pm

Answer **FOUR** questions only.

Q1.

ChemSoft chemical company uses a chemical machine to produce a new chemical. The chemical machine uses two chemicals and produces a new product. You need to design and develop a security system to control the above chemical machine. The machine has four controls such as pressure of the machine (A), concentration of chemical 1 (B), Temperature of the machine (C) and concentration of chemical 2 (D).

The dangerous situations are listed below. All controls have two states such as Hi or Low. (Assume that Hi =1 and Low = 0)

The following stage are harmful (Use these conditions as TRUE (1))

- All control values are low ($\overline{A}\,\overline{B}\,\overline{C}\,\overline{D} = 1$)
- Pressure of the machine and concentration of chemical 1 is Hi and other values are low ($A.B.\overline{C}.\overline{D} = 1$)
- Only the pressure is Hi ($A.\overline{B}.\overline{C}.\overline{D} = 1$)
- All control values are Hi (A.B.C.D = 1)
- Only the concentration of Chemical 2 is Low ($A.B.C.\overline{D} = 1$)
- Pressure of the machine and Temperature are Hi and other values are Low ($A.\overline{B}.C.\overline{D} = 1$)

The following states are NOT harmful (Use these conditions as DO NOT CARE)

- Only the concentration of Chemical 1 is Hi and other values are low
- Only the concentration of Chemical 1 is Low and other values are Hi
- The temperature is Hi and other values are Low

a. Construct a TRUTH table for the above security system

b. Get the minimum expression for the above system Using the K-MAP Method.

c. Prove that the above expression is the minimum expression by using the Algebraic method.

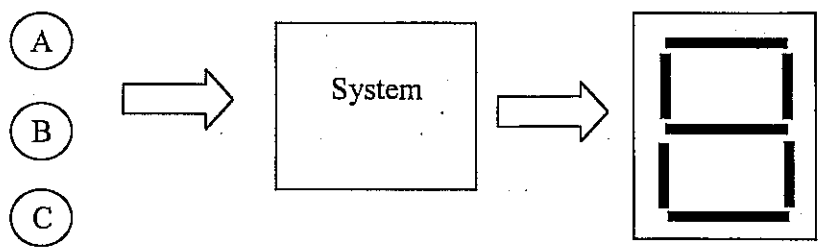
d. Design a digital circuit for the above expression by using basic gates.

e. Design a digital circuit for the above expression by using NAND gates only.

Q2.

a. Briefly describe the following:
   i. 7 segment Display
   ii. 8 to 3 encoder

b. International Cricket Council (ICC) needs to design a new display board to display runs in the next ICC cricket tournament. There are 3 buttons available on the board. User needs to press a combination of the buttons, and then the system shows the appropriate runs on the board.



Button number	Display number
No button pressed	-
A only	1
B Only	2
A and B Only	3
C only	4
A and C Only	5
B and C Only	6

i. Create a truth table for each button.

A	B	C	a	b	c	d	e	f	g
0	0	0							
0	0	1							
0	1	0							
0	1	1							
1	0	0							
1	0	1							
1	1	0							

ii. Construct the function for each output(a to g)

iii. Implement the circuit by using basic gates.

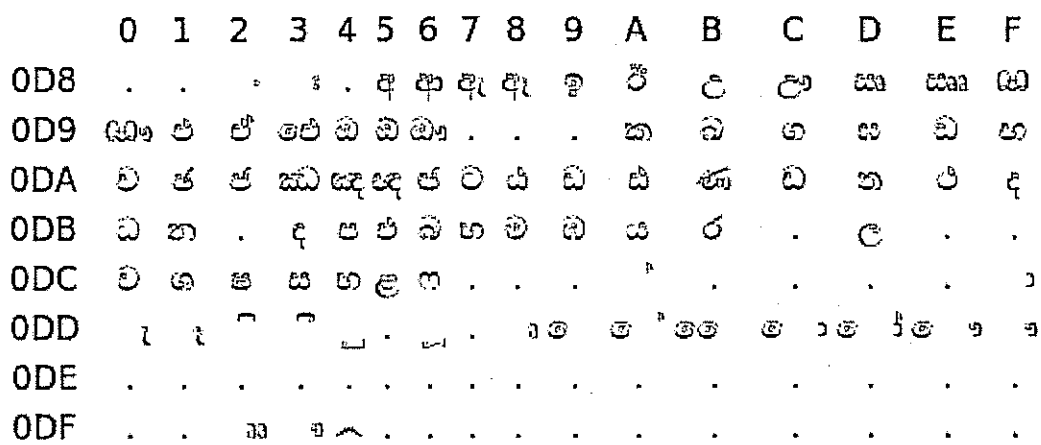
iv. ICC noted that multiple key press event (Example; Press B and C) has some troubles. Therefore they introduced 7 buttons that are used to display these display numbers. How would you improve the existing system by using 8 to 3 encoder, Explain briefly?

Q3.

a. Briefly explain the following terms.
   i. File System
   ii. Character, number and image representation in a computer

[25]

b. Following diagram shows a Sinhala UNICODE character map. Answer the following question using this Sinhala UNICODE character map.



	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0D8	.	.	◌	◌	.	අ	ආ	ඇ	ඈ	ඉ	ඊ	උ	ඌ	ඍ	ඎ	ඏ
0D9	ඐ	එ	ඒ	ඓ	ඔ	ඕ	ඖ	.	.	.	ක	ඛ	ග	ඝ	ඞ	ඟ
0DA	ච	ඡ	ජ	ඣ	ඤ	ඥ	ඦ	ට	ඨ	ඩ	ඪ	ණ	ඬ	ත	ථ	ද
0DB	ධ	න	.	ඳ	ප	ඵ	බ	භ	ම	ඹ	ය	ර	.	ල	.	.
0DC	ව	ශ	ෂ	ස	හ	ළ	ෆ	.	.	.	◌	.	.	.	.	◌
0DD	◌	◌	◌	◌	◌	.	◌	.	◌	◌	◌	◌	◌	◌	◌	◌
0DE	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
0DF	.	.	◌	◌	◌	.	.	.	.	.	.	.	.	.	.	.

   i. What is the value range of the Sinhala Unicode?
   ii. What are the Unicode values for Sinhala letters අ, ර ?
   iii. By using 16 bit registers, store the above values (Q3.b.ii).

c. Convert the following numbers into Binary(base 2), Octal(Base 8) and hexadecimal(Base 16)
   i. 79_{10} ii. 37_{10}

d. Use Two's Complement addition to perform the following calculations
   i. $79_{10} + 37_{10}$ ii. $79_{10} - 37_{10}$ iii. $-79_{10} + 37_{10}$
   iv. $-79_{10} + -37_{10}$

Q4.

a. Briefly describe the following
   i. The Von-Neuman Computer model
   ii. The System bus model
   iii. Fetch-execute cycle
   iv. The memory hierarchy of a computer

b. What are the advantages and disadvantages of the Assembly Language?

c. Consider the following simple Assembly language program (The program has 5 lines)

```
1. ! This program add two numbers

2.      .begin
3.      .org 2048

4.  Pro1:ld       [r1], %x1
         Ld       [r2], %x2
         Addcc    %x1, %x2, x3
         St       %x3,[r3]
5.      .end
```

Explain the task of the each line

Q5

a. Write short notes for the following
   i. Multiplexer
   ii. Counters
   iii. Registers

b. Draw a circuit diagram and a truth table for the S-R Flip-flop.

c. Using the S-R basic Flip-flop implement the following
   i. Clocked S-R Flip-flop
   ii. D Flip-flop
   iii. J-K Flip-flop

d. Draw a 2 bit register with Enable(EN), Clock(CLK) and Write(WR) controls

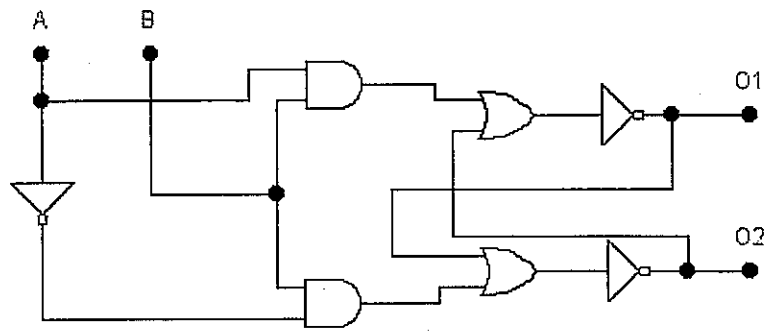
Q6.

a. Describe the following terms used in computer Hardware:
   i. HD – 160GB, 7200RPM, SATA
   ii. DDR II 2GB, 800MHz
   iii. DVD +RW

b. "PORTs can be used to communicate with the computer". Do you agree with this statement? Explain briefly.

c. What are the differences between CMOS and TTL IC Types?

d. Draw a IC circuit for the following Digital circuit (A, B inputs & O1,O2 are outputs)



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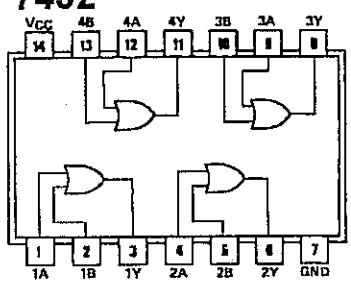

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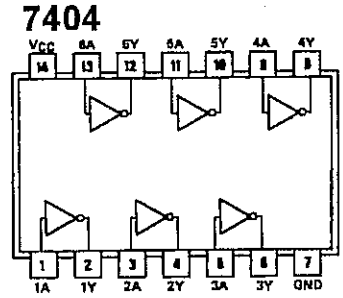

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