UNIVERSITY OF GHANA

B.SC INFORMATION TECHNOLOGY, FIRST SEMESTER

EXAMINATIONS: 2016/2017

CSIT 307: DIGITAL LOGIC AND SYSTEMS DESIGN (3 CREDITS)

INSTRUCTION:

***Answer All Questions in Sections A and Any Three (3) Questions from Section* B**

TIME ALLOWED:

TWO AND A HALF (2½) HOURS

SECTION A (40 MARKS)

ANSWER ALL QUESTIONS IN THIS SECTION

A1. Convert the following binary numbers to base 10

a) 10101101 b) 110110.1 c) 1.00101 [3 marks]

A1. Determine the base b in each of the following cases:

a) $(361)_{10}=(551)_b$ b) $(859)_{10}=(5B7)_b$ c) $(982)_{10}=(1726)_b$ [6 marks]

A1. Write down the 8-bit *i*) 2's complement form for each of the following decimal numbers:

a) +119 b) -77 c) -3 [3 marks]

A1. Perform the following arithmetic operations using 2's complement arithmetic and assuming a word length of 8 bits:

(a)	(b)	(c)

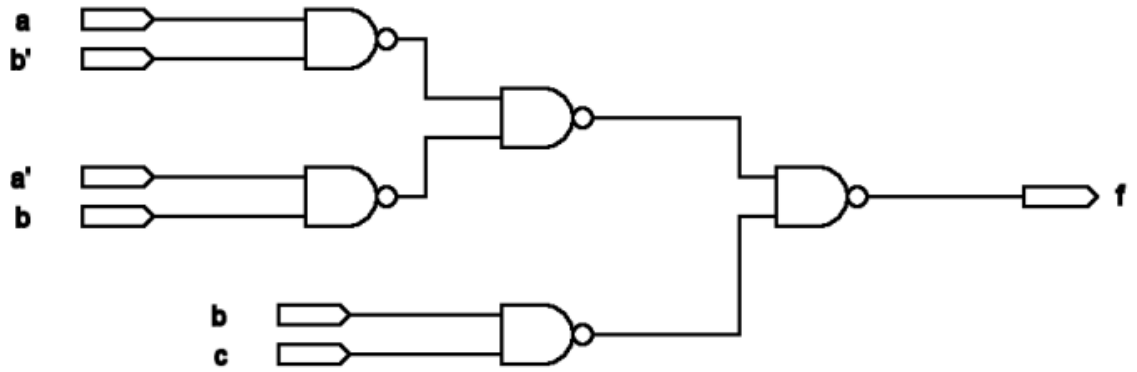
[6 marks]

A1. Minimise the following functions and implement the minimised function using NAND gates only:

f(A,B,C)=0,1,2,3,4,5,6 [5 marks]

f(A,B,C,D)=0,2,8,9,10,12,13,14 [5 marks]

A1. Write down the output function for the circuit shown below



A1. Draw the minimum cost AND-OR implementation for *f*. Input variables are available in true and complement forms.

[6 marks]

A1. Design a logic circuit with three inputs A, B, C and one output F such that F=1 only when a majority of the inputs is equal to 1. [6 marks]

SECTION B (60 MARKS)

ANSWER ANY THREE (3) QUESTIONS IN THIS SECTION

B1.

a. With the aid of a suitable diagram explain the difference between a sequential circuit and a combinational circuit. [5 marks]

b. What is a Finite State Machine (FSM)? [3 marks]

c. Describe the steps involved in the design of Finite state machines [6 marks]

d. Distinguish between a Mealy machine Moore Machine [6 marks]

B1.

a) What is a program status word and why is it important? [4 marks]

b) Describe the important bits of the program status word [6 m arks]

c) Explain the function of the Program Counter and Stack?

[4 marks]

d) Show the stack and the stack pointer from the following. Assume the default stack area.

```
Mov R6, #25H
Mov R1, #12H
Mov R4, #0F3H
PUSH 6
PUSH 1
PUSH 4
```

[6 marks]

B1.

a. Explain what you understand by the term Embedded Systems. Illustrate your answer with two real world examples. the following terms. [4 marks]

b. Explain the following terms, *hard real time, soft real time and firm real time* 6 marks

c. Are all embedded systems real time? Are all real time systems embedded? Jus tify your answer. [4 marks]

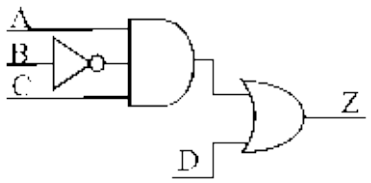
d. Give two examples of an infamous embedded system failure and for one of them explain the reasons for the failure. [6 marks]

B1. The main stairway in a block of flats has three switches for controlling the lights. Switch A is positioned at the bottom of the stairs, switch B is located halfway up the stairs and switch C is located at the top of the stairs. Design a logic network to control the lights on the staircase. [20 marks]

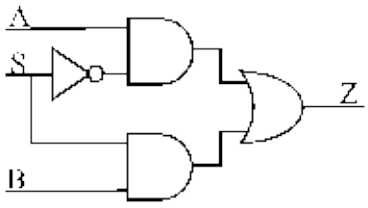
B2.

a. For each of the following logic diagrams, write the Boolean logic equation directly from the diagram and obtain the complete truth table:

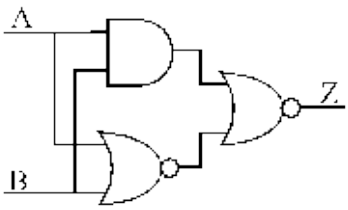
i



ii



iii



[12 marks]

a. For each of the following logic equations, draw the complete logic diagram directly from the logic equation and obtain the complete truth table:

Z = ABC’ + AB’C + A’BC + ABC

A = ((X Y)’ + Z’)’ (Y’ + X’ Z)’ [8 marks]