

**NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY**  
**FACULTY OF APPLIED SCIENCES**  
**COMPUTER SCIENCE DEPARTMENT**  
**SUPPLEMENTARY EXAMINATIONS, JULY 2005**

**SUBJECT:** LOGIC DESIGN AND SWITCHING CIRCUITS  
**CODE:** SCS 1204

**INSTRUCTIONS TO CANDIDATES**

*This examination paper consists of SIX (6) questions, all questions carry equal marks.  
Answer any FIVE (5) questions*

**Time: 3 hours**

1. a) A device accepts natural binary numbers in the range 0000 to 1111 that represent 0 to 15. The output of the circuit is true if the input to the circuit represents a prime number and is false otherwise. A prime number is an integer that is greater than 1 and is divisible only by 1 and itself. Zero and 1 are not prime numbers.
- i) Draw the truth table to represent the function
  - ii) From the truth table obtain the SOP expression for this function and hence design a circuit using AND, OR, and NOR gates to carry out this function.
  - iii) Draw the Karnaugh map and hence obtain a simplified SOP expression for the function.
  - iv) Express the function in POS. [15]
- b) Explain why the method of 2's complement arithmetic is commonly used as compared to other methods. [5]
2. a) Starting from the NOR representation of an S-R flip-flop, deduce its characteristic truth table by considering all possible logic levels. [6]
- b) Write the SOP and POS forms for the Truth table below. Simplify the SOP expression using a Karnaugh map. [8]

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

c) i) Give examples of areas where floating-point number representation is necessary. [3]

ii) State examples of situations where fixed-point number representation is useful and often used. [3]

3. a) With the aid of appropriate examples, explain the meaning of the following terms:

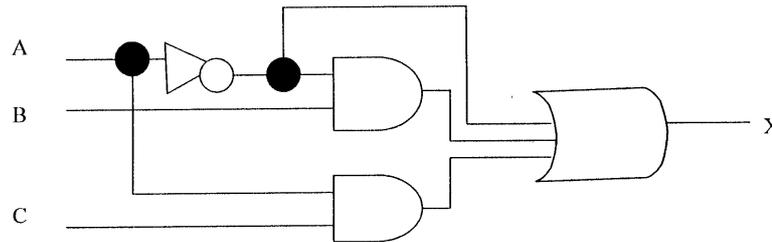
- i) SOP [10]
- ii) POS
- iii) Minterm
- iv) Truth table
- v) Karnaugh map

b) State and explain De Morgan's theorems. [3]

c) Perform the following conversions:

- i.  $(126)_{10} = ( )_2$
- ii.  $(1010111)_2 = ( )_{BCD}$
- iii.  $(32.6)_{10} = ( )_2$

d) Write the output expression for the circuit below [3]



4. a) Determine the expression for the output Y and write the Truth table for the circuit shown in figure 1. [6]

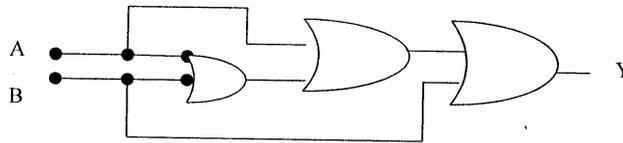


Figure 1

- b) Simplify the following Boolean expressions using Boolean theorems. [2]
- i.  $\overline{ABC} + \overline{AB}C$
  - ii. Convert the following into sum of products form and minimise using the Karnaugh map.  
 $F = (AB + C)(B + \overline{CD})$  [8]
- c) What is a shift register and why is it so important in digital systems? [4]
5. a) Derive excitation tables of the following flip-flops. [5]
- i. J-K flip-flop [5]
  - ii. S-R flip-flop [5]
- b) Simplify the following using K-map [10]
- $$F(A,B,C,D) = (1,2,5,6,9) + d(10,11,12,13,14,15)$$
6. a) Design a FULL ADDER circuit and determine its output expression for SUM and CARRY. [8]
- b) Differentiate between the following: [6]
- i) +ve logic & -ve logic
  - ii) combinational & sequential ckts
  - iii) Synchronous and asynchronous counters

c) Determine the product terms of the Karnaugh Map in the figure below and write the resulting minimum SOP expression: [6]

CD \ AB	00	01	11	10
00			1	1
01	1	1	1	1
11	1	1	1	1
10		1		

**END OF QUESTION PAPER**