**CHUKA** **UNIVERSITY**

**UNIVERSITY EXAMINATIONS**

**THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE IN COMPUTER SCIENCE**

**COSC 312: COMPONENTS AND DESIGN TECHNIQUES FOR DIGITAL SYSTEMS**

**STREAMS: BSC (COMPUTER SCIENCE)** **TIME: 2 HOURS**

**DAY/DATE: MONDAY 10/12/2018** **11.30 A.M. – 1.30 P.M.**

---

**CANDIDATE INSTRUCTIONS**

- Answer **all questions** in section A and any other **two questions** from section B.
- No Reference Material is allowed in the exam Room.
- All Mobile phones should be switched off in the exam room.
- Use diagrams where possible to illustrate your answer

**SECTION A (COMPULSORY)**

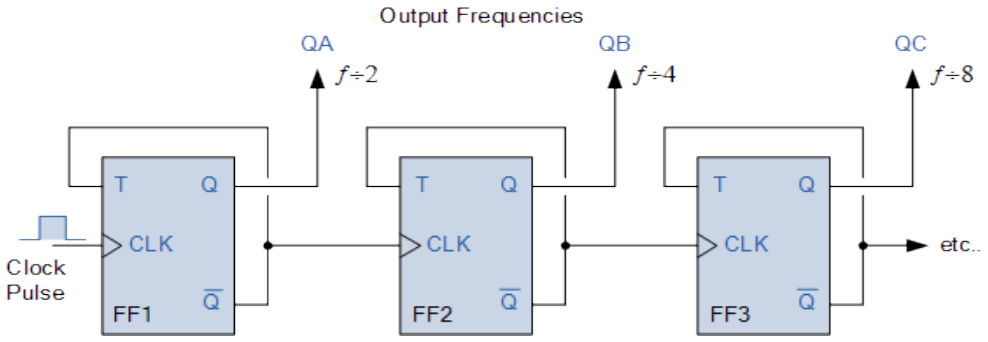
**QUESTION 1(COMPULSORY) [30 MARKS]**

a) With the help of a diagram, differentiate between Mealy and Moore machine (4marks)

b) Explain the four basic movement of data through a shift register (4 marks)

c) Using "*ieee.std_logic_1164.all"* library, write aVHDL code of a 4 bit counter. (5marks)

d) Below is a diagram of a divide by x (where x=2, 4 and 8), use it to answer the questions below.



i) Explain how the above flip flop circuit works (3marks)
ii) Write the truth table of the circuit in d(i) above (3marks)

e) Below is a truth table for the conversion of binary number to Gray code. Use it to answer the questions below.

| Binary | | | Gray code | | |
|---|---|---|---|---|---|
| *a* | *b* | *c* | *x* | *y* | *z* |
| 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 |

i) Write the un-minimized SOP logic circuit equations that converts binary to Gray code (3marks)
ii) Minimize the equations above (6marks)
iii) Draw the minimized SOP single circuit of binary to gray code (2marks)

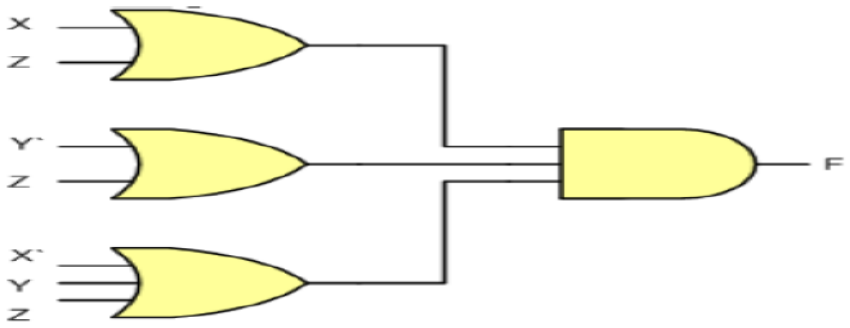
**SECTION B (**Answer **two question** from this section**)**

**QUESTION 2 [20 MARKS]**

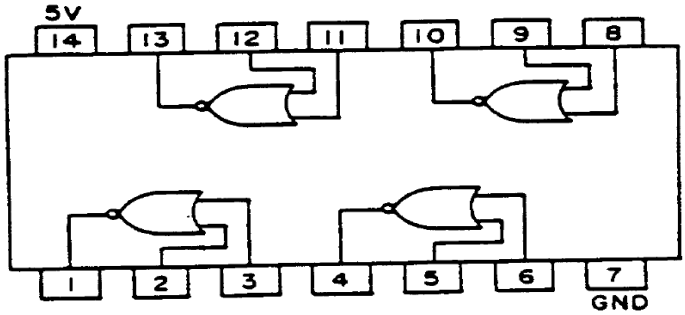
a) A certain digital device could count number 1up to 8 in binary numbers. Draw a POS circuit which will enable this device to give an output logic 1, only where there are two consecutive ones. i.e. 011, 110 etc. (5 marks)

b) Use Boolean algebra lawsto prove that the following circuits are the same
i) $(A + B)(\bar{A}+C) = AC + \bar{A}B$ (4 marks)
ii) $A + \bar{A}\,B = A + B$ (3 marks)

c) Below is a circuit implemented using OR gates and NOR gates, use it to answer the questions below.




i) Convert the above circuit to use NOR gates only (4marks)
ii) Show the circuit diagram showing the implementation of the above circuit using the 7400 series NOR gate IC below (4marks)




**QUESTION 3 [20 MARKS]**

a) With reference to digital comparator (that compares 2-inputs A and B, then gives 3-outputs C, D and E).
   i) Draw the truth table of the comparator, such that: - if A<B then only C is logic high, else if A=B then only D is logic high, otherwise if A>B then only E is logic high (4marks)
   ii) Draw a circuit diagram of the above comparator( show workings) (6marks)

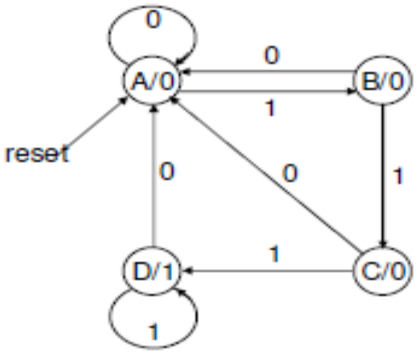
b) Using a TTL diagram, explain the operation of a NOR gate. (4 marks)

c) With the help of a circuit diagram, explain how a 4 to 1 multiplexer work (6 marks)

**QUESTION 4 [20 MARKS]**

a) With the help of a diagram, explain how a decimal to 4bit binary encoder functions (7 marks)

b) Below is a FSM (finite state machine), use it to answer the questions below




   i) Write the state transition table (4 marks)
   ii) Use K-map to minimize the outputs (5 marks)
   iii) Draw the circuit of the minimized output (4 marks)

**QUESTION 5 [20 MARKS]**

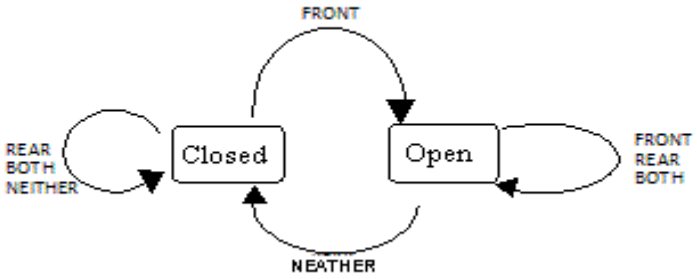
a) Use the following circuit to answer the questions below

$G = (A+B)(A+\bar{C}) + A\bar{B}$

i) Perform a K-Map SOP minimization of the above logic equation (4 marks)
ii) Perform aK-Map POS minimization of the above logic equation (3 marks)

b) With reference to digital substractor (let it incorporate the borrow or opposite of carry)
i) Using a truth table, explain the operation of a substractor (4 marks)
ii) Draw the circuit diagram of the substractor (show minimizations) (6 marks)

c) Below is a simple door open and lock FSM, explain how it functions (3 marks)




---