

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

RESIT/SPECIAL EXAMINATION

THIRD YEAR EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR
OF COMPUTER SCIENCE

COSC 312: COMPONENTS AND DESIGN TECHNIQUES FOR DIGITAL SYSTEMS

STREAMS: BSC

TIME: 2 HOURS

DAY/DATE: WEDNESDAY 03/02/2021

5.00 P.M – 7.00 P.M.

INSTRUCTIONS

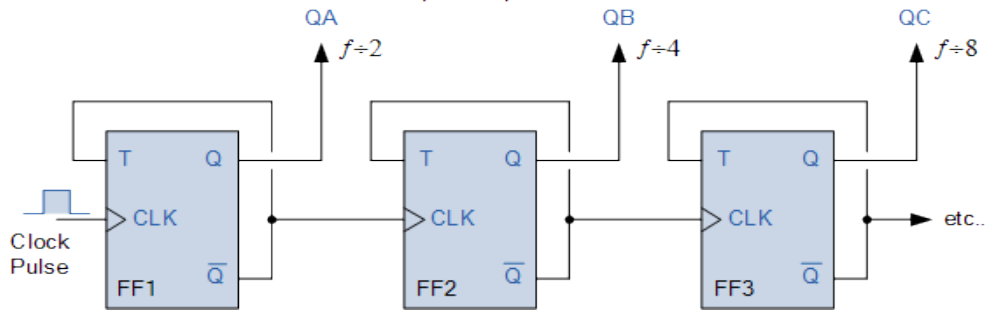
- Answer **all questions** in section A and any other **two questions** from section B.
- No Reference Material is allowed in the exam Room.
- All Mobile phones should be switched off in the exam room.
- Use diagrams where possible to illustrate your answer

SECTION A (COMPULSORY)

QUESTION 1(COMPULSORY) [30 MARKS]

- a) With the help of a diagram, differentiate between Mealy and Moore machine (4 marks)
- b) Explain the four basic movement of data through a shift register (4 marks)
- c) Using “*ieee.std_logic_1164.all*” library, write a VHDL code of a 4 bit counter. (5 marks)
- d) Below is a diagram of a divide by x (where $x=2, 4$ and 8), use it to answer the questions below.

COSC 312
Output Frequencies



- i) Explain how the above flip flop circuit works (3 marks)
 - ii) Write the truth table of the above circuit in d(i) above (3 marks)
- e) Below is a truth table for the conversion of binary number to Gray code. Use it to answer the questions below.

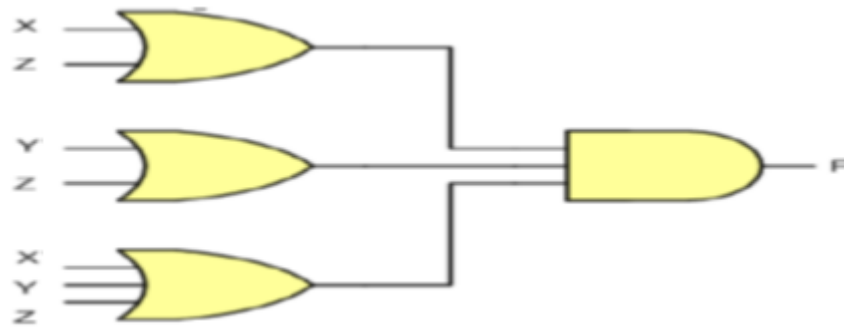
Binary			Gray code		
<i>a</i>	<i>b</i>	<i>c</i>	<i>x</i>	<i>y</i>	<i>z</i>
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	0	1	1
0	1	1	0	1	0
1	0	0	1	1	0
1	0	1	1	1	1
1	1	0	1	0	1
1	1	1	1	0	0

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

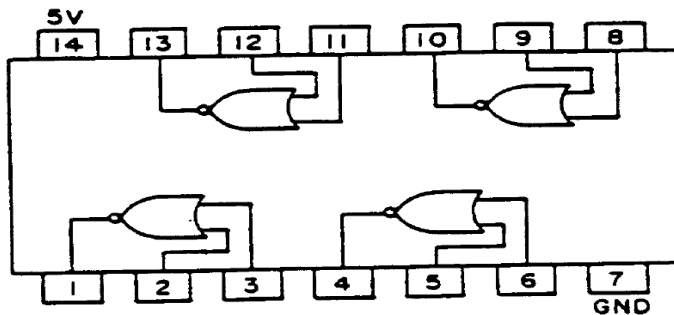
SECTION B (Answer two question from this section)

QUESTION 2 [20 MARKS]

- a) A certain digital device could count number 1 up to 8 in binary numbers. Draw a POS circuit which will enable this to device give output of logic 1, only where there are two consecutive ones. i.e. 011, 110 etc. (5 marks)
- b) Use Boolean algebra laws to prove that the following circuits are the same
 - i) $(A + B)(\bar{A} + C) = AC + \bar{A}B$ (4 marks)
 - ii) $A + \bar{A}B = A$ (3 marks)
- c) Below is a circuit implemented using OR gates and AND 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)

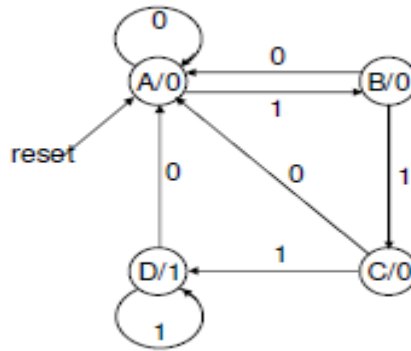


QUESTION 3 [20 MARKS]

- 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 (4 marks)
 - ii) Draw a circuit diagram of the above comparator(show workings) (6 marks)
- 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 coded decimal 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 a K-Map POS minimization of the above logic equation (3 marks)
- b) With reference to digital subtractor (let it incorporate the borrow or opposite of carry)
- i) Using a truth table, explain the operation of a subtractor (4 marks)
 - ii) Draw the circuit diagram of the subtractor (show minimizations) (6 marks)
- c) Below is a simple door open and lock FSM, explain how it functions (3 marks)

