**Department Of Mathematics**

**Ahmadu Bello University, Zaria**

**First Semester Examination 2009/2010 Session**

**COSC205: Digital logic design**

**Instructions: Answer Any Four Questions. Time Allowed: 2 Hours 15 mns**

1. Explain what you understand by sequential circuit and state three differences between combinational and sequential circuit.
2. The results of an experiment fall in the range -4 to 9. A scientist wishes to read the result into a computer and then process them. He decides to use a 4-bit binary code to represents each of the possible inputs. Devise a 4-bit binary code capable of representing numbers in the range of -4 to 9
3. A logical circuit has two JK flip flops, A and B, one input X as shown in the figure below:



**QA**

**QB**

1. Derive the state table of the circuit.
2. Derive the state diagram of the circuit
3. Differentiate between Big-endian and little- endian with respect to data representation and show how the hexadecimal number C5DE is represented in Big-endian and in little- endian.
4. Knowing that the Bias in IEEE single format is 127, derive the decimal number represented in IEEE single format as: 11000001100000010000000000000000
5. i. Using AND OR and NOT gates only, Design circuit diagrams to generate P and Q from inputs X,Y and Z, where P=(X+Y’)(XZ) and Q=Y’Z+XYZ’. Do not simplify these expressions.

ii. By mean of truth table establish the relationship between P and Q.

iii. Compare the circuit diagram in term of speed(Propagation Delay) and cost implementation.

1. Explain what you understand by combinational circuit and state the characteristics of problems for which the solution can be implemented by using a combinational circuit
2. Differentiate between the product of maxterm and the product of sum and then convert the following expression to the product of maxterm: P= AB+A’B’ +(A+B+C)
3. A logical circuit has two JK flip flops, A and B, one inputs X and one output Y. the flip flop input functions and the circuit output function are as follows:

JA=BX+A KA=X+B JB=X’ KB=X Y=AB

1. Draw the logical diagram of the circuit
2. Derive the state table
3. Derive the state diagram
4. Let P=10110011 and Q=00111010. Perform the following operation using two complement:
5. P-Q ii. Q-P
6. Johnson counters are a variation of standard ring counters, with the inverted output of the last stage fed back to the input of the first stage. Consider a four bit Johnson counter shown in the diagram below:



Assuming that the initial state, the flip flops of the counter are cleared, determine the state sequence for the counter.( the state of the counter after each shift)

1. A circuit has four inputs, P,Q,R,S, representing the natural binary numbers 0000=0 to 1111=15. P is the most significant bit. The circuit has two output, X and Y. the output X is true if the number represented is divisible by three.(Regard 0 as being indivisible by three) and the output Y is true if the number represented is a prime number(Note that zero(0000) and one (00001) are not considered as prime number)
2. Design a truth table for this circuit and hence obtain the Boolean equations for X and Y and in terms of P,Q,R,S.
3. Obtain a simplified expression for X and Y using Karnaugh map.
4. Design a circuit to implement this function assuming that logic gates to be used have fan in of at most 2 .
5. Briefly describe the functionality of R-S flip flop.
6. Simplify the following expression using algebraic manipulation

F=AB’C’+A’B’C’+A’BC’+A’B’C

X=A’B’+BC’+AB’C’+ABC’D

Y=1+ABC+ A’B’C’+ A’B’C+ A’BC’+ A’BC+ ABC’+ AB’C’+ AB’C+ AB’C’

1. Design a counter with the following repeated binary sequence: 0, 4, 2, 1, 6. Using T flip-flops
2. Differentiate between Mealy and Moore model of sequential circuit.
3. Explain what you understand by universal gate and by using diagrams, show how the logic AND and the logic OR can be derived from NOR gate.
4. Ruwaida, Amina and Zainab live in the same house. Unfortunately there are only two keys available that unlock the front door. One of which is kept by Amina and the other by Zainab. The door is always locked when no one is at home. However, when Ruwaida is out when someone else is home, the door is left unlock so that Ruwaida can enter when she returns. If Ruwaida is at home either alone or not, the door may be either locked or unlocked since anyone else who may be out has a key. If Ruwaida returns to an empty house she must wait until Zainab or Amina is back. Ruwaida, Amina and Zainab are busy people living independent life and cannot easily account for who is at home and who is not.

Design the truth table that indicate the status of the door D(uses door open=1 and door locked=0 ).

1. Derive a Boolean equation D that specified when the door is opened.
2. Simplify the obtained expression of D taking into consideration the don’t care condition.
3. Design a circuit that implement D.