KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS
MAIN CAMPUS
FIRST SEMESTER 2018 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF SCIENCE IN INFORMATION TECHNOLOGY

COMP 213: DIGITAL CIRCUIT DESIGN

STREAM: Y2S1 **TIME: 2:00-4:00PM**

EXAMINATION SESSION: DECEMBER **DATE: 3/12/2018**

VENUE:AUDIT **COPIES:60**

INSTRUCTIONS:

1. **This question paper has five questions**
2. **QUESTION ONE IS COMPULSORY AND HAS 30 MARKS**
3. **Answer any other two questions worth 20 marks each.**

QUESTION ONE (30 marks)

(a) Explain the commutative law of Boolean algebra (3marks)

(b) What is the difference between sum of product (SOP) and Product of sum (POS)? Give an example in each (2marks)

(c) Simplify the following function using Boolean algebra. Draw the circuits before and after simplification. $x'y\,z' + x'y\,z$ (5mks)

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(d) State any two universal logic gates and give the truth table of each of them (2mks)

(e) Show that A+(B.C) is logically equivalent to (A+B)(A+C). Draw the logic circuits for each (6mks)

(f) Why is binary numbers relevant in digital devices such as computers? (2mks)

(g) If a 3-input NAND gate has eight input possibilities, show all the possibilities with their respective outputs (4mks)

(h) What is the difference between sum of product (SOP) and Product of sum (POS)? Give an example in each (2mks)

(i) State any four postulates of Boolean algebra. (4mks)

QUESTION TWO (20 marks)

(a) Draw the half adder circuit and give the equations of the outputs of the sum and carry (5mks)

(b) Consider the following logic function

F(A,B,C, D) = ∑(1,2, 3,4, 7, 8, 9,13,14)

i) Prepare the K-map for this function (4mks)

ii) Using the prepared K-map, write down the simplified logic expression and draw logic circuit for the resulting function (4mks)

(c) Prove using a truth table, that the given logic functions are similar. ***Y=(A+B)'*** and ***Y=A'.B'*** (4marks)

(d) Differentiate between sequential and combinational circuit (3marks)

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QUESTION THREE (20 marks)

(a) Explain the importance of Boolean algebra in the design of digital circuits?(2marks)

(b) Applying DeMorgan's theorem to simplify the following expression $\overline{\overline{(X + Y)} + \overline{Z}}$ (3marks)

(c) Differentiate between leading and trailing edge in clock used for memory elements (2mks)

(d) Given a karnaugh map below

AB \ CD				
	1	1	1	1
	1			**1**
	1			**1**
			1	1

What is the representation of the expression of the above table? Write a simplified logic expression for the given logic K-maps (6mks)

(e) Design a combinational circuit that will realize the following Boolean function ***A+B((C.D)(A+B))*** (3mks)

(f) Explain duality in De Morgan's Theorem. Prove the second De Morgan's theorem using a truth table (4mks)

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QUESTION FOUR (20 marks)

(a) Show the map by their equivalent decimal values in the respective cells in a 4 input variable K-map (4mks)

*(b) C*onstruct a 4-to-1 multiplexer showing all the possible inputs and output. **(5mks)**

(c) Explain the RS Flip-flop using a diagram to demonstrate how one state of a bit can be 'remembered' as long as the power is supplied. (3mks)

(d) (i) Draw a logic circuit diagram of a full adder circuit. (4mks)

(ii) Develop the truth table of the full adder circuit in (i). (4mks)

QUESTION FIVE (20 marks)

a) Explain the implementation of 3-8 decoder using AND gate **(4mks)**

b) Use the Karnaugh map to solve the following function

$F1(x, y, z) = \Sigma(3, 5, 6, 7)$ **(4mks)**

c) Explain the distributive law of boolean algebra **(2mks)**

d) Differentiate between leading and trailing edge in clock used for memory elements **(2mks)**

e) Explain duality in De Morgan's Theorem. Prove the second De Morgan's theorem using a truth table (4mks)

f) Draw a circuit to realize following function **F = (x + y)(x +y')** **(4mks)**

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KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

MAIN CAMPUS

THIRD SEMESTER, 2017/2018 ACADEMIC YEAR

EXAMINATION FOR BACHELOR OF SCIENCE IN COMPUTER SCIENCE

BACHELOR OF INFORMATION TECHNOLOGY

COMP 213/COMP 223: DIGITAL CIRCUIT DESIGN

STREAM: Y2S1 & Y2S2 **TIME: 2HRS**

EXAMINATION SESSION: AUGUST **YEAR: 25/7/2017**

INSTRUCTIONS

1. **This question paper has five questions**
2. **Answer question one and any other three questions**

QUESTION ONE (30 marks)

(a) Explain the RS Flip-flop using a diagram to demonstrate how one state of a bit can be 'remembered' as long as the power is supplied. (3mks)

(b) State any two universal logic gates (2mks)

(c) Show that a + bc is logically equivalent to (a + b)(a + c). Draw the logic circuits for each (6mks)

(d) Why do digital computers use binary numbers in their operations? (2mks)

(e) If a 3-input NAND gate has eight input possibilities, show all the possibilities with their respective outputs (4mks)

(f) What is the difference between sum of product (SOP) and Product of sum (POS)? Give an example in each (2mks)

(g) Show the map by their equivalent decimal values in the respective cells in a 2 input variable K-map (3mks)

(h) Explain duality in De Morgan's Theorem. Prove any one of the De Morgan's theorem using a truth table (4mks)

(i) State any four postulates of Boolean algebra. (4mks)

QUESTION TWO (20 marks)

(a) Consider the following logic function

F(A,B,C, D) = ∑(11,9,7,6,5,4,3,1)

i) Prepare the K-map for this function (4mks)

ii) Using the prepared K-map, write down the simplified logic expression and draw logic circuit for the resulting function (4mks)

(b) Using a truth table, determine if the given logic functions are similar. ***Y=(A.B)'*** and ***Y=A'+B'*** ***(3mks)***

(c) What is the importance of a clock in a flip flop (2mks)

(d) Draw the half adder circuit and give the equations of the outputs of the sum and carry (5mks)

(e) Explain the following

i) Karnaugh map (1mk)

ii) Combinational logic circuit (1mk)

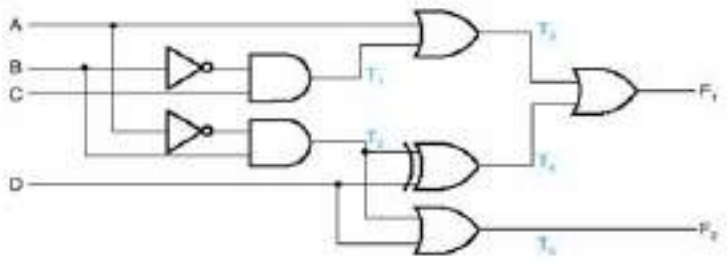
QUESTION THREE (20 marks)

(a) Given a karnaugh map below

AB \ CD				
	1	1	1	1
	1	1		
	1	1		
	1	1	1	1

What is the representation of the expression of the above table? Write a simplified logic expression for the given logic K-maps (6mks)

(b) Derive the Boolean expression for F_1 and F_2 by giving the intermediate outputs T_1 to T_5 in the logic circuit shown below. Formulate the truth table from the circuit.



(5mks)

(c) Show that $(A+B).(A+C) = A+B.C$ (3mks)

(d) Draw the circuit using AND gate and OR gate to implement XOR gate (2mks)

(e) Use the Boolean theorem to simplify the following logic function.
$(X'.Y'.Z')'.Z+(X'.Y'.Z')'+W$ (4mks)

QUESTION FOUR (20 marks)

(a) Suppose we find that a logic circuit has the Boolean expression ***x'y z' + x'y z***. Simplify this circuit using Boolean algebra. Draw the circuits before and after simplification. (5mks)

(b) State the output logic equation of a RS-flip-flop and develop its truth table. (3mks)

(c)

(d) Define Programmable Logic Devices (PLDs). Draw a Programmed Array Logic to implement the following equation. ***Y=A'B'+A'B+AB*** *(4Mks)*

(e) (i) Draw a logic circuit diagram of a full adder circuit. (4mks)

(ii) Develop the truth table of the full adder circuit in (i). (4mks)

QUESTION FIVE (20 marks)

a) Implement a 3-input NAND operation equivalence using an inverter and OR gate (3mks)

b) State any four postulates of Boolean algebra. (4mks)

c) Draw the full adder circuit and give the equations of the outputs of the sum and carry (5mks)

d) Convert the following into decimal equivalence $C4A_{16}$ (4mks)

e) Explain with example the three input Karnaugh map (4mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD SEMESTER, 2017/2018 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN COMPUTER SCIENCE

COMP 213:/INTE326/COSF 316 DIGITAL CIRCUIT DESIGN

STREAM: Y2S1 **TIME: 2.00-4.00PM**

EXAMINATION SESSION: AUGUST **DATE: 13/8/2018**

INSTRUCTIONS:

1. **This question paper has five questions**
2. **QUESTION ONE IS COMPULSORY AND HAS 30 MARKS**
3. **Answer any other two questions worth 20 marks each.**

QUESTION ONE (30 marks)

a) What makes it appropriate for digital systems such as computers to work on binary variables in their operations? **(2mks)**

b) Show any three disadvantages of analog signals over digital signal **(3mks)**

c) Construct a three input NAND gate giving its logic equation and all the possible outputs in a truth table. **(5mks)**

d) Explain the duality of De-Morgan's Theorem **(2mks)**

e) Draw the block diagram of half adder giving the equations for the outputs with their truth table. **(5mks)**

f) Demonstrate the use of buffers in digital electronics **(2mks)**

g) If a 3-input XNOR gate has eight input possibilities, show all the possible outputs with their respective outputs. **(4mks)**

*h) C*onstruct a8-to-1 multiplexer showing all the possible inputs and output. **(5mks)**

i) Draw the symbol and the equation for XOR gate **(2mks)**

QUESTION TWO (20 marks)

a) Prove that a NOR gate is equivalent to a bubbled AND gate **(3mks)**

b) Explain any three characteristics of a combinational circuit **(3mks)**

c) Give any three applications of decoders **(3mks)**

d) Draw the block diagram for S-R latch using NAND gate. What happens when all the inputs are '1'? **(4mks)**

e) Prove that $A\ (B+C) = (A\ B) + (A\ C)$ **(4mks)**

f) Draw the circuit diagram for the equation $F(x, y, z) = y + x'z$. **(3mks)**

QUESTION THREE (20 marks)

a) What is the difference between sum of product(SOP) andproduct of sums(POS) forms **(2mks)**

b) What is the difference between an encoder and a multiplexer **(2mks)**

c) Use the Boolean algebra to minimize the following equation

$F=(x'+y'+x'y'+xy)(x'+yz)$ **(4mks)**

d) Show that $(a + b)(a + c)$ is logically equivalent to $a + bc$. Draw the logic circuits for each **(6mks)**

e) Explain the following

i) Karnaugh map **(2mks)**

ii) Combinational logic circuit **(2mks)**

f) What is the importance of a clock in a flip flop **(2mks)**

QUESTION FOUR (20 marks)

a) Explain the use of exclusive-OR in the design of full adder **(3mks)**

b) To reduce the number of intergrated circuits, multiplexer is used. Explain how a 4-line to 1-line multiplexer works **(4mks)**

c) Simplify the following expression using a Karnaugh map:

$$A.\overline{B}.\overline{C} + \overline{A}.B.\overline{C} + A.\overline{B}.C + \overline{A}.B.C$$

(4mks)

d) Show the map by their equivalent decimal values in the respective cells in a 4 input variable K-map **(3mks)**

e) State any four postulates of Boolean algebra. **(4mks)**

f) What is the equivalence of 2-input XOR equation **(2mks)**

QUESTION FIVE (20 marks)

a) Explain the implementation of 3-8 decoder using AND gate **(5mks)**

b) Use the Karnaugh map to solve the following function

$F1(x, y, z) = \Sigma(3, 5, 6, 7)$ **(4mks)**

c) Explain the distributive law of boolean algebra **(2mks)**

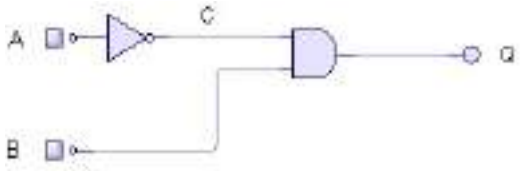
d) Differentiate between leading and trailing edge in clock used for memory elements

(2mks)

e) Draw the half adder circuit and give the equations of the outputs of the sum and carry

(3mks)

f) Study the following logic system carefully and then draw the truth table for it



(4mks)

KABARAK **UNIVERSITY**

UNIVERSITY EXAMINATIONS

SECOND SEMESTER, 2016/2017 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN COMPUTER SCIENCE

COMP 213/COMP223: DIGITAL CIRCUIT DESIGN

STREAM: Y2S1 **TIME:**

EXAMINATION SESSION: DECEMBER **DATE: 2017**

INSTRUCTIONS:

1. **This question paper has five questions**
2. **QUESTION ONE IS COMPULSORY AND HAS 30 MARKS**
3. **Answer any other two questions worth 20 marks each.**

QUESTION ONE (30 marks)

(a) Show the map by their equivalent decimal values in the respective cells in a 3 input variable K-map (3mks)

(b) Use the Boolean theorem to simplify the following logic function.
(X'.Y'.Z')'.Z+(X'.Y'.Z')'+W (4mks)

(c) State any two universal logic gates and give the truth table of each of them (2mks)

(d) State the output logic equation of a RS-flip-flop and develop its truth table. (3mks)

(e) Show that A+(B.C) is logically equivalent to (A+B)(A+C). Draw the logic circuits for each (6mks)

(f) Why is binary numbers relevant in digital devices such as computers? (2mks)

(g) If a 3-input NAND gate has eight input possibilities, show all the possibilities with their respective outputs (4mks)

(h) What is the difference between sum of product (SOP) and Product of sum (POS)? Give an example in each (2mks)

(i) State any four postulates of Boolean algebra. (4mks)

QUESTION TWO (20 marks)

(a) Draw the half adder circuit and give the equations of the outputs of the sum and carry (5mks)

(b) Consider the following logic function

F(A,B,C, D) = ∑(13,14,9,8,7,6,5,4,3,2,1)

i) Prepare the K-map for this function (4mks)

ii) Using the prepared K-map, write down the simplified logic expression and draw logic circuit for the resulting function (4mks)

(c) Using a truth table, determine if the given logic functions are similar. *Y=(A.B)'* and *Y=A'+B'* *(3mks)*

(d) What is the importance of a clock in a flip flop (2mks)

(e) Differentiate between sequential and combinational circuit (2mks)

QUESTION THREE (20 marks)

(a) Differentiate between leading and trailing edge in clock used for memory elements (2mks)

(b) Given a karnaugh map below

AB \ CD				
	1	1	1	1
	1	1		
	1	1		
			1	1

What is the representation of the expression of the above table? Write a simplified logic expression for the given logic K-maps (6mks)

(c) Design a combinational circuit that will realize the following Boolean function $A+B((C.D)(A+B))$ (3mks)

(d) Show that $(A+B).(A+C) = A+B.C$ (3mks)

(e) Draw the circuit using AND gate and OR gate to implement XOR gate (2mks)

(f) Explain duality in De Morgan's Theorem. Prove the second De Morgan's theorem using a truth table (4mks)

QUESTION FOUR (20 marks)

(a) Suppose we find that a logic circuit has the Boolean expression $x'y\,z' + x'y\,z$. Simplify this circuit using Boolean algebra. Draw the circuits before and after simplification. (5mks)

(b) Explain the RS Flip-flop using a diagram to demonstrate how one state of a bit can be 'remembered' as long as the power is supplied. (3mks)

(c) Define Programmable Logic Devices (PLDs). Draw a Programmed Array Logic to implement the following equation. $Y=A'B'+A'B+AB$ *(4Mks)*

(d) (i) Draw a logic circuit diagram of a full adder circuit. (4mks)

(ii) Develop the truth table of the full adder circuit in (i). (4mks)

KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

SECOND SEMESTER, 2016/2017 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN COMPUTER SCIENCE

COMP 213: DIGITAL LOGIC DESIGN

STREAM: Y2S1 **TIME:**

EXAMINATION SESSION: MARCH **DATE: 2017**

INSTRUCTIONS:

1. **This question paper has five questions**
2. **QUESTION ONE IS COMPULSORY AND HAS 30 MARKS**
3. **Answer any other two questions worth 20 marks each.**

Question One: [30 MARKS]

a. Why do digital computers use binary numbers in their operations? (2mks)
b. If a 3-input XNOR gate has eight input possibilities, show all the possibilities with their respective outputs (4mks)

c. What is the difference between sum of product (SOP) and Product of sum (POS)? Give an example in each (2mks)
d. What is a Karnaugh map? Show the map by their equivalent decimal values in the respective cells in a 3 input variable map (3mks)
e. *Explain* the demultiplexer and a decoder as an applicationdevice of logic circuit (4mks)
f. Explain duality in De Morgan's Theorem. Prove any one of the De Morgan's theorem using a truth table (4mks)
g. Why is Boolean algebra relevant in the design of logic circuits of computers? (2mks)
h. Explain the RS Flip-flop using a diagram to demonstrate how one state of a bit can be 'remembered' as long as the power is supplied. (3mks)
i. State any four postulates of Boolean algebra. (4mks)
j. Draw a logic symbol of a two input NAND gate with its truth table (2mks)

Question Two: [20 MARKS]

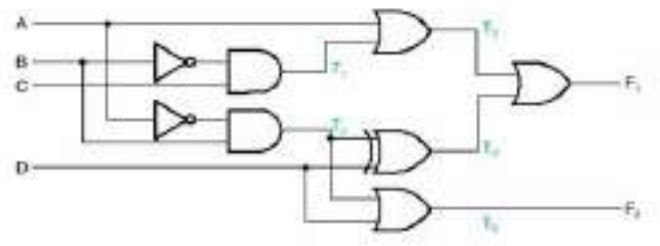
a. Draw a combinational circuit that will implement the following two logic function;
(i) ***AB + A(B + C) + B(B + C)***. (ii) **(W'+XY)(X+YZ)'** (8mks)
b. Using a truth table, determine if the given logic functions are similar. ***Y=(A.B)'*** and ***Y=A'+B'*** ***(3mks)***
c. What is the importance of a clock in a flip flop (2mks)
d. Draw the half adder circuit and give the equations of the outputs of the sum and carry (5mks)
e. Explain the following logic circuits
i) Sequential logic circuit (1mk)
ii) Combinational logic circuit (1mk)

Question Three: [20 MARKS]

a. Explain the two input XNOR gate giving all their possible combinations and their outputs (3mks)

b. Consider the following four variable function: ***f(w, x, y, z)=∑(1, 3 , 6, 7, 8, 9, 12, 13, 15).*** Write the unsimplified function in algebraic form. Using Karnaugh map, minimize the function in the most appropriate form giving the simplified equation (8mks)

c. Derive the Boolean expression for F_1 and F_2 in the logic Circuit shown below



(4mks)

d. Show that ***(A+B).(A+C) = A+B.C*** (3mks)

e. Draw the circuit using AND gate and OR gate to implement XOR gate (2mks)

Question Four: [20 MARKS]

a. Simplify the following expression using three variable maps.

1. F(x,y,z)=∑(0,1,5,7)

2. F(x,y,z)=∑(1,2,3,6,7) (6mks)

b. Define Programmable Logic Devices (PLDs). Draw a Programmed Array Logic to implement the following equation. ***Y=A'B'+A'B+AB*** *(4Mks)*

c. Give any two uses of a truth table (2mks)

d. (i) Draw a logic circuit diagram of a full adder circuit. (4mks)

(ii) Develop the truth table of the full adder circuit in (i). (4mks)

Question Five: [20 MARKS]

a. What is the difference between a buffer and an inverter (2mks)

b. Use the Boolean theorem to simplify the following logic function.
(A'.B'.C')'.C+(A'.B'.C')'+D (4mks)

c. Draw a full adder and show in a truth table the outputs of the sum and carry (6mks)

d. Draw an RS Flip flop using two NAND gates and show the expected outputs of Q and Q' for all possible combination of RS inputs (6mks)

e. What property do sequential circuits have that combinational circuits do not have?(2mks)