∨ (or) ∧ (And)
¬ (NOT)
→ if then (conditional)
↔ if and only if. (Biconditional)

Class Exercise 4

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Boolean Algebra and Digital circuits

Question 1:

Using truth table determine whether the following two statements are logically equivalent:

Answer : Yes logically equivalent

¬(p→q) and p∧¬q

(not q) (not q)

Explain how you know you are correct.

NOT (negation)

¬ (NOT negation) (p→q) (if.. then) Conditional

p ∧ ¬q AND Conjunction

(~~Not q~~) → (p∧¬q) (Not q)

~~(Not q)~~ → (Not q)

p	q	¬q	~~¬(p→q)~~
F	F	T	F
F	T	F	F
T	F	T	T
T	T	F	F

✓

p	q	¬(p→q)
F	F	F
F	T	F
T	F	T
T	T	F

p	q	~q	p∧~q
0	0	1	
0	1	0	
1	0	1	
1	1	0	

Question 2:

Make a truth table for the statement

$\neg p \rightarrow (q \wedge r)$

p	q	r	(¬p →(Q∧R))
F ~~0~~	F ~~0~~	~~0~~ F	~~0~~ F
F ~~0~~	~~0~~ F	T	~~0~~ F
F	T	F	F
F	T	T	T
T	F	F	T
T	F	T	T
T	T	F	T
T	T	T	T

Question 3:

Let p, q, and r be the following propositions:

p: You get an A on the final exam

q: You do every exercise in the book.

r: You get an A in this class.

Write the following formulas using p, q, and r and logical connectives.

1. You get an A in this class, but you do not do every exercise in the book.
2. To get an A in this class, it is necessary for you to get an A on the final.
3. Getting an A on the final and doing every exercise in the book is sufficient for getting an A in this class.

1. $r \land \neg q$
2. $r \to p$ (if)
3. $(p \land q) \to r$

Question 4:

State the converse and contrapositive of each of the following implications.

a) If it snows today, I will stay home.
b) We play the game if it is sunny.
c) If a positive integer is a prime then it has no divisors other than 1 and itself.

a. Converse - If I stay home, it snows today
Contrapositive - If I do not stay home, it does not snow today

b. Converse - If we play the game, then it is sunny
Contrapositive If we dont play the game, it is not sunny

c. Converse - If positive integer has no divisors other than 1 and itself it is a prime
Contrapositive - If positive integer has divisions other than 1 and itself then it is not a prime.

Question 5 (Next week in Week 5):

Which of the truth tables (i , ii) below represents the behaviour of NAND gate?

INPUT		OUTPUT
A	B	
0	0	1
1	0	1
0	1	1
1	1	0

i

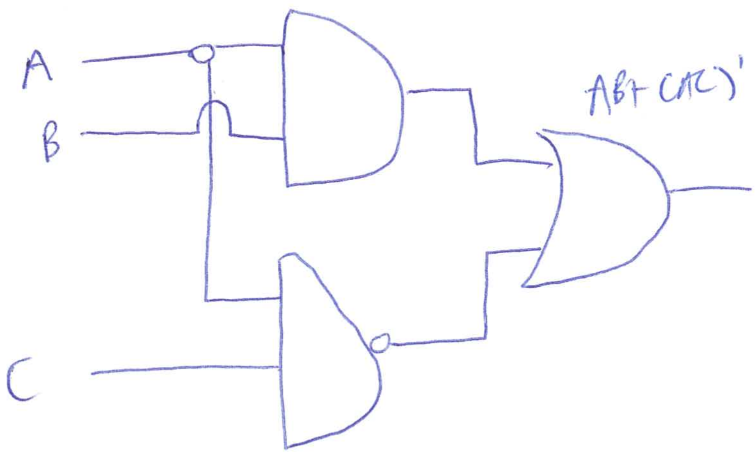
INPUT		OUTPUT
A	B	
0	0	0
1	0	0
0	1	0
1	1	1

ii

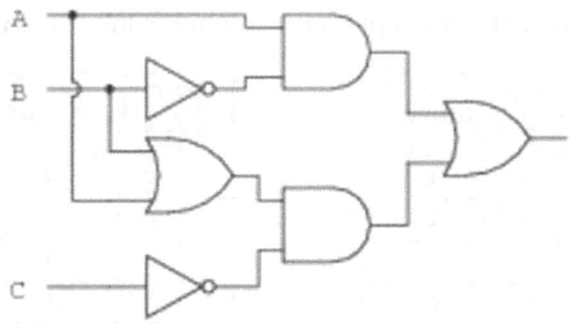
AND Gate

Answer: i NAND Gate

Draw a circuit diagram corresponding to the following Boolean expression
AB + (AC)'



An engineer hands you a piece of paper with the following gate circuit and asks you what could be the equivalent Boolean expression on it:



$AB' + C'(A+B)$

Question 6 (Next week in Week 5):

Using the laws of logic prove that the statements $\neg(p \rightarrow q)$ and $p \wedge \neg q$ are logically equivalent. (Hint: first you can use conditional law and logically equivalent statement for it)

Conditional/implication law

$\neg(p \rightarrow q)$ implication as disjunction logically equivalent

$\neg(\neg p \vee q)$

$\neg\neg p \wedge \neg q$ de morgans law

$p \wedge \neg q$ double negation

answer: $\neg(p \rightarrow q) \equiv p \wedge \neg q$

Condition law $p \rightarrow q$ as $\neg p \vee q$

p	a	$\neg(p \rightarrow q)$	$p \wedge \neg q$
1	0	1	1
1	1	0	1
0	0	1	0
0	1	0	0