University of Bahrain
Department of Mathematics
MATHS253: Set Theory
Fall 2018
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Homework 2: Truth Table
Due October 11, 2018

Name: _____

1. Construct the truth table of each of the following:
   1. $\neg p \wedge q$.

   2. $(p \to q) \to (q \to p)$.

   3. $p \to (\neg q \to r)$.

4. $\neg(p \wedge q) \oplus (\neg p \vee \neg q)$.

2. Show that the following proposition is a tautology $(p \to q) \to (\neg p \vee q)$.

3. Show that the following proposition is a contradiction $(\neg p \to \neg q) \wedge \neg(p \vee \neg q)$.

4. De Morgan's Laws are very useful laws in logic. Prove the following two De Morgan's laws:

   1. $\neg(p \wedge q) \equiv \neg p \vee \neg q$.

2. $\neg(p \vee q) \equiv \neg p \wedge \neg q$.

3. What is the negation of the statement "You can pay me now or you can pay me later".

5. The following logically equivalents proposition are important in logic and will be used frequently. Prove each one of them

   1. (Associative law) $p \vee (q \vee r) \equiv (p \vee q) \vee r$ (similar statement holds true for $\wedge$).

   2. (Distributive law) $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$.

   3. (Proof by cases) $p \vee q \to r \equiv (p \to r) \wedge (q \to r)$.

6. Discuss the truth values for the following statement and state what is the problem in such statements?

   p : " I am a liar"

7. A course syllabus has the following policy about the getting A in the class: ”If you don’t do every exercise in the book, then if you get an A, then you were cheating.”. Show that this complicated policy is the same as the following sentence ”If you get an A, then you did every exercise in the book or you were cheating”.