Laws of Equivalence

Given any statement variables p, q and r, a tautology $\mathbf{t}$ and a contradiction $\mathbf{c}$, the following logical equivalences hold.

Law	**Logical Equivalences**
Commutative	$p \wedge q \equiv q \wedge p$ $p \vee q \equiv q \vee p$
Associative	$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$ $(p \vee q) \vee r \equiv p \vee (q \vee r)$
Distributive	$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$ $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$
Identity	$p \wedge \mathbf{t} \equiv p$ $p \vee \mathbf{c} \equiv p$
Negation	$p \vee \sim p \equiv \mathbf{t}$ $p \wedge \sim p \equiv \mathbf{c}$
Double negation	$\sim (\sim p) \equiv p$
Idempotence	$p \wedge p \equiv p$ $p \vee p \equiv p$
Universal bound	$p \vee \mathbf{t} \equiv \mathbf{t}$ $p \wedge \mathbf{c} \equiv \mathbf{c}$
DeMorgan's Laws	$\sim (p \wedge q) \equiv \sim p \vee \sim q$ $\sim (p \vee q) \equiv \sim p \wedge \sim q$
Absorption	$p \vee (p \wedge q) \equiv p$ $p \wedge (p \vee q) \equiv p$
Negations of $\mathbf{t}$ and $\mathbf{c}$	$\sim \mathbf{t} \equiv \mathbf{c}$ $\sim \mathbf{c} \equiv \mathbf{t}$
Implication	$p \to q \equiv \sim p \vee q$
Negation of a conditional	$\sim (p \to q) \equiv p \wedge \sim q$
Contrapositive	$p \to q \equiv \sim q \to \sim p$
If and only if	$p \leftrightarrow q \equiv (p \to q) \wedge (q \to p)$ $p \leftrightarrow q \equiv (p \wedge q) \vee (\sim p \wedge \sim q)$