Laws of Equivalence

Given any statement variables p, q, and r, a tautology t and a contradiction c, the following logical equivalences hold:		
1. Commutative laws:	$p \wedge q \equiv q \wedge p$	$p \vee q \equiv q \vee p$
2. Associative laws:	$(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$	$(p \vee q) \vee r \equiv p \vee (q \vee r)$
3. Distributive laws:	$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$	$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$
4. Identity laws:	$p \wedge t \equiv p$	$p \vee c \equiv p$
5. Negation laws:	$p \vee \sim p \equiv t$	$p \wedge \sim p \equiv c$
6. Double negative law:	$\sim(\sim p) \equiv p$	
7. Idempotent laws:	$p \wedge p \equiv p$	$p \vee p \equiv p$
8. DeMorgan's laws:	$\sim(p \wedge q) \equiv \sim p \vee \sim q$	$\sim(p \vee q) \equiv \sim p \wedge \sim q$
9. Universal bounds laws:	$p \vee t \equiv t$	$p \wedge c \equiv c$
10. Absorption laws:	$p \vee (p \wedge q) \equiv p$	$p \wedge (p \vee q) \equiv p$
11. Negations of t and c:	$\sim t \equiv c$	$\sim c \equiv t$
12. Definition of $\to$:	$p \to q \equiv \sim p \vee q$	
13. Definition of $\leftrightarrow$:	$p \leftrightarrow q \equiv (p \to q) \wedge (q \to p)$	

Rules of Inference

Modus Ponens	Modus Tollens	Conjunction	Transitivity
$p \to q$ p $\therefore q$	$p \to q$ $\sim q$ $\therefore \sim p$	p q $\therefore p \wedge q$	$p \to q$ $q \to r$ $\therefore p \to r$

Elimination		Generalization	
$p \vee q$ $\sim q$ $\therefore p$	$p \vee q$ $\sim p$ $\therefore q$	p $\therefore p \vee q$	q $\therefore p \vee q$

Specialization		Contradiction rule	Proof by division into cases
$p \wedge q$ $\therefore p$	$p \wedge q$ $\therefore q$	$\sim p \to \boldsymbol{c}$ $\therefore p$	$p \vee q$ $p \to r$ $q \to r$ $\therefore r$