Equivalence Rules

1 Double negation (DN)

$p \equiv \sim\sim p$

2 De Morgan's theorem (DeM)

$\sim(p \wedge q) \equiv \sim p \vee \sim q$

$\sim(p \vee q) \equiv \sim p \wedge \sim q$

3 Commutation (Comm)

$p \vee q \equiv q \vee p$

$p \wedge q \equiv q \wedge p$

4 Association (Asso)

$p \vee (q \vee r) \equiv (p \vee q) \vee r$

$p \wedge (q \wedge r) \equiv (p \wedge q) \wedge r$

5 Distribution (Dist)

$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$

$p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$

6 Contraposition (Contra)

$p \rightarrow q \equiv \sim q \rightarrow \sim p$

7 Implication (Impl) [or def $\rightarrow$]

$p \rightarrow q \equiv \sim p \vee q$

8 Definition of $\leftrightarrow$ (def $\leftrightarrow$)

$(p \leftrightarrow q) \equiv (p \rightarrow q) \wedge (q \rightarrow p)$

$(p \leftrightarrow q) \equiv (p \wedge q) \vee (\sim p \wedge \sim q)$

$(p \leftrightarrow q) \equiv \sim(p \oplus q)$

9 Identity

$p \wedge T \equiv p$

$p \vee F \equiv p$

10 Domination

$p \vee T \equiv T$

$p \wedge F \equiv F$

11 Idempotent (Idem)

$p \vee p \equiv p$

$p \wedge p \equiv p$

12 Tautology

$p \vee \sim p \equiv T$

13 Contradiction

$p \wedge \sim p \equiv F$

14 Definition of $\oplus$ (def $\oplus$)

$p \oplus q \equiv (p \vee q) \wedge \sim(p \wedge q)$

$p \oplus q \equiv (p \wedge \sim q) \vee (q \wedge \sim p)$

Valid Argument forms

1 Modus Ponens (MP)

$p \rightarrow q$

$p \quad \therefore q$

2 Modus Tollens (MT)

$p \rightarrow q$

$\sim q \quad \therefore \sim p$

3 Disjunctive Syllogism (DS)

$p \vee q$

$\sim p \quad \therefore q$

or

$p \vee q$

$\sim q \quad \therefore p$

4 Simplification (Simp)

$p \wedge q \quad \therefore p$ or $p \wedge q \quad \therefore q$

5 Conjunction (Conj)

p

$q \quad \therefore p \wedge q$

6 Hypothetical Syllogism (HS)

$p \rightarrow q$

$q \rightarrow r \quad \therefore p \rightarrow r$

7 Addition (Add)

$p \quad \therefore p \vee q$, where q is any statement

8 Resolution (Res)

$\sim p \vee q$

$p \vee r \quad \therefore q \vee r$