Logic → study of formal reasoning

Proposition → Statements that are either true or false
→ typically declartive sentences
→ "Are you awake?" is NOT a propisition
→ commands are NOT propositions

A Propositions Truth Value → the value indicating whether the proposition is true or false
→ Values can be true, false, unknown or a matter of opinion

Proposition Variables (p, q, r) → denote arbitrary propositions

Compound Propos-tion → connecting individual propositions with logic operations
→ "$\land$" means AND

Truth Table → shows all scenarios of a compound proposition

Disjunction Operation → "$\lor$" meas INCLUSIVE OR

Exclusive OR → Exactly 1 proposition is true but NOT BOTH
→ Symbol "$\oplus$"

Negation Operation → acts on only one proposition
→ read as "not p"
→ symbol "$\neg$"

Order of operations without parentheses

1. $\neg$ (not)
2. $\wedge$ (and)
3. $\vee$ (or)

Conditional Operation → "if p then q"
→ symbol "$p \to q$"
→ where p is the hypothesis and q is the conclusion
→ if the hypothesis is false then the conditional statement is true regardless

Converse, contrapositive, and inverse of $p \to q$

Converse: $q \to p$

contrapositive: $\neg q \to \neg p$

Inverse: $\neg p \to \neg q$

Biconditional Operation: "p if and only if q"
symbol: "$p \leftrightarrow q$"
- this is only true if p and q have the same truth value

Tautology → a compound proposition that is always true

Contradiction → a compound proposition that is always false

Logically Equivalent → Two compound propositions are logically equivalent if they have the same truth value regardless of the truth values of their individual propositions.

Notation: $s \equiv r$

De Morgan's Laws: logical equivalences that show how to correctly distribute a negation operation inside parnthesized expressions.

1st Law: $\neg(p \vee q) \equiv (\neg p \wedge \neg q)$

2nd Law: $\neg(p \wedge q) \equiv (\neg p \vee \neg q)$