

**Math 300 Intro Math Reasoning**  
**Worksheet 01: Mathematical logic**

(1) Prove that  $P \implies Q$  and  $\neg Q \implies \neg P$  are logically equivalent but that  $P \implies Q$  and  $Q \implies P$  are not logically equivalent.

(2) Prove that  $\neg(P \wedge Q)$  and  $(P \wedge \neg Q) \vee \neg P$  are logically equivalent.

(3) Prove that  $P \iff Q \equiv (P \implies Q) \wedge (Q \implies P)$ .

(4) Suppose that  $\alpha \equiv T$  and  $\beta \equiv F$ , for each of the following determine if whether they are a tautology or a contradiction:

(1)  $(\beta \wedge \alpha) \implies \beta$ .

(2)  $\beta \wedge (\alpha \implies \beta)$ .

(5) Decide whether the conclusion follows from the premises:

- Pre. 1:  $A \implies (B \implies C)$
- Pre. 2:  $\neg B \vee (\neg C)$
- Conclusion  $\neg B \vee \neg A$ .