CS 210 Homework 1

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Problem 1

1. IF triangle ABC is isosceles THEN triangle ABC is equilateral
2. IF triangle ABC is NOT isosceles THEN triangle ABC is NOT equilateral
3. Triangle ABC is equilateral IF AND ONLY IF triangle ABC is equiangular
4. Triangle ABC is isosceles AND triangle ABC is NOT equiangular
5. IF triangle ABC is equiangular THEN triangle ABC is isosceles

Problem 2

1.

Truth Table

P	Q	R	$(P \oplus Q)$	$((P \oplus Q) \iff R) = LHS$
F	F	F	F	T
F	F	T	F	F
F	T	F	T	F
F	T	T	T	T
T	F	F	T	F
T	F	T	T	T
T	T	F	F	T
T	T	T	F	F

$(P \iff R)$	$(Q \iff R)$	$(P \iff R) \oplus (Q \iff R)$	$LHS \iff RHS$
T	T	F	F
F	F	F	T
T	F	T	F
F	T	T	T
F	T	T	F
T	F	T	T
F	F	F	F
T	T	F	T

Not a Tautology

2.

Truth Table

P	Q	$\neg P$	$\neg Q$	$(P \vee Q)$	$(P \to \neg Q)$	$(Q \to \neg P)$
F	F	T	T	F	T	T
F	T	T	F	T	T	T
T	F	F	T	T	T	T
T	T	F	F	T	F	F

$(P \to \neg Q) \vee (Q \to \neg P)$	$(P \vee Q) \wedge (P \to \neg Q) \vee (Q \to \neg P)$
T	F
T	T
T	T
F	F

3.

$$(P \vee Q) \wedge ((\neg P \vee \neg Q) \vee (\neg Q \vee \neg P))$$
$$(P \vee Q) \wedge (\neg(P \wedge Q) \vee \neg(Q \wedge P))$$
$$(P \vee Q) \wedge \neg((P \wedge Q) \wedge (Q \wedge P))$$
$$(P \vee Q) \wedge \neg(P \wedge Q)$$

P OR Q AND NOT (P AND Q)
So, we can have either P or Q but not both, this is the XOR Operation.

4. Exclusive OR (XOR/$\oplus$)

Problem 3

1. $P(x) \wedge Q(X) \to R(x)$
2. $\neg P(x) \wedge \neg S(X) \to \neg R(x)$
3. $P(x) \wedge Q(X) \to \neg R(x)$
4. $\exists x \quad P(x) \wedge \neg R(x)$
5. $\forall x \quad S(x) \wedge Q(x) \to R(x)$
6. $\exists x \quad \neg P(x) \wedge \neg Q(x) \to \neg R(x)$
7. $\forall x \quad P(x) \to Q(x)$
8. $\forall G \, \exists x \quad \neg P(x) \wedge R(x)$

Problem 4

1.

$$\exists x \, \exists y \quad \neg[\neg(x > y) \vee (x - y > 0)]$$
$$\exists x \, \exists y \quad [(x > y) \wedge \neg(x - y > 0)]$$
$$\exists x \, \exists y \quad [(x > y) \wedge (x - y \leq 0)]$$

2.

$$\begin{aligned}
&\exists x\ \exists y \quad \neg[(x < y) \rightarrow \exists z\ (x < z < y)] \\
&\exists x\ \exists y \quad \neg[\neg(x < y) \vee \exists z\ (x < z < y)] \\
&\exists x\ \exists y \quad [(x < y) \wedge \neg\exists z\ (x < z < y)] \\
&\exists x\ \exists y \quad [(x < y) \wedge \forall z\ \neg(x < z < y)]
\end{aligned}$$