King Saud University
First quizz Math 151 - Section 348
Date: 12/2/2020
Time Limit: 30 Minutes

Name : Answer

Assistant prof: *Dr Borhen Halouani*

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1. (3 points) Draw the truth table of the following statement: $(p \to q) \vee (\neg p \to \neg q)$.

3

p	q	$\neg p$	$\neg q$	$(p\to q)$	$\neg p \to \neg q$	$(p\to q)\vee(\neg p\to\neg q)$
T	T	F	F	T	T	T
T	F	F	T	F	T	T
F	T	T	F	T	F	T
F	F	T	T	T	T	T

So $(p\to q)\vee(\neg p\to \neg q)$ is a tautology

2. (4 points) Using logic laws, show that $(p \to q) \wedge r \equiv \neg(r \to p) \vee \neg(r \to \neg q)$.

4

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

3. (3 points) State the converse, the inverse and the contrapositive for the following statement: "If $m.n = l$, then $m \geq 0$ or $n \geq 0$ or $l \geq 0$, where $m, n, l \in \mathbb{Z}$."

1
- The converse is: If $m\geq 0$ or $n\geq 0$ or $l\geq 0$ then $mn=l$.

1
- The inverse is: If $mn\neq l$ then $m<0$ and $n<0$ and $l<0$.

1
- The contrapositive is: If $m<0$ and $n<0$ and $l<0$ then $mn\neq l$.

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1. (3 points) Draw the truth table of the following statement: $\neg(p \to q) \leftrightarrow (p \wedge \neg q)$.

3

p	q	$\neg q$	$p \to q$	$\neg(p\to q)$	$p \wedge \neg q$	$\neg(p\to q) \leftrightarrow (p\wedge\neg q)$
T	T	F	T	F	F	T
T	F	T	F	T	T	T
F	T	F	T	F	F	T
F	F	T	T	F	F	T

So $\neg(p\to q) \leftrightarrow (p \wedge \neg q)$ is a tautology $\Leftrightarrow$ $\neg(p \to q) \equiv p \wedge \neg q$

2. (4 points) Using logic laws, show that $(u \wedge w) \to [v \to (u \wedge v \wedge w)]$ is a tautology.

4

$$(u \wedge w) \to [v \to (u \wedge v \wedge w)] \equiv$$
$$\neg(u \wedge w) \vee [v \to (u \wedge v \wedge w)] \equiv$$
$$\neg(u \wedge w) \vee [\neg v \vee (u \wedge v \wedge w)] \equiv$$
$$[\neg(u \wedge w) \vee \neg v] \vee (u \wedge v \wedge w) \equiv$$
$$\underbrace{\neg(u \wedge v \wedge w)}_{\neg A} \underbrace{\vee}_{\vee} \underbrace{(u \wedge v \wedge w)}_{A} \equiv T$$

3. (3 points) State the converse, the inverse and the contrapositive for the following statement: "If the integer $a+b-c$ is an even , then a is even or b is even or c is even, where $a, b, c \in \mathbb{Z}$."

1
- The converse is: If a is even or b is even or c is even then $(a+b-c)$ is even

1
- The inverse is: If $(a+b-c)$ is odd then a, b, c are all odd.

1
- The contrapositive is: If a odd and b odd and c odd then $(a+b-c)$ odd