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HW-0

Q1)

a) If $\underbrace{\text{you are happy}}_{p}$ $\underbrace{\text{and}}_{\wedge}$ $\underbrace{\text{watch movies}}_{q}$, then $\underbrace{\text{your parents ask you to study}}_{r}$.

propositions:

p: "You are happy"

q: "You watch movies"

r: "Your parents ask you to study"

Relation using logical operators:

$$(p \wedge q) \rightarrow r.$$

b) $\underbrace{\text{You are a Bangladeshi}}_{b}$ $\underbrace{\text{or}}_{\vee}$ if $\underbrace{\text{you are not a bangladeshi}}_{\neg b}$, then $\underbrace{\text{your friend is European}}_{e}$.

propositions:

b: "You are a Bangladeshi."

$\neg$b: "You are not a Bangladeshi".

e: "Your fiend is European".

Relation using logical operators:

$\cancel{p}$ $\quad b \vee (\neg b \rightarrow e)$

Q2| Given,

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

$\equiv (p \wedge (\neg p \vee q)) \rightarrow q$ Logical equilivalance of implication

$\equiv ((p \wedge \neg p) \vee (p \wedge q)) \rightarrow q$; Distributive Law

$\equiv (F \vee (p \wedge q)) \rightarrow q$; Negetion Law

$\equiv (p \wedge q) \rightarrow q$; Identity Law

$\equiv \neg (p \wedge q) \vee q$; Logical equilivalance of implication.

$\equiv (\neg p \vee \neg q) \vee q$; Demorgans Law

$\equiv \neg p \vee (q \vee \neg q)$; Associative Law

$\equiv \neg p \vee T$; Negetion Law

$\equiv T$; Domination Law

$\therefore (p \wedge (p \rightarrow q)) \rightarrow q$ is a tautology.

Q3|

p	q	r	$\neg q$	$\neg r$	$p \vee \neg r$	$(\neg q) \rightarrow (p \vee \neg r)$
T	T	T	F	F	T	T
T	T	F	F	T	T	T
T	F	T	T	F	T	T
T	F	F	T	T	T	T
F	T	T	F	F	F	T
F	T	F	F	T	T	T
F	F	T	T	F	F	F
F	F	F	T	T	T	T

$(\neg q) \rightarrow (p \vee \neg r)$

$\therefore$ It is a contigency.

Q4| "For you to get a good job in Pathao, it is sufficient for you to learn CSE173".

propositions:

p: "~~For~~ you to get a good job in Pathao."

q: "You to learn CSE 173."

Relation using logical operators:

~~$p \rightarrow q$~~ $q \rightarrow p$

HW-1

Problem 1

a) If $2+7=6$, then crocodilies can fly

Here,
$p: 2+7=6$ which is false and q: crocodilies can fly is false. So, ~~form~~ from the truth table of $p \to q$ suggest that the statement is true.

Answer: True.

b) If $5+5=10$, then dogs can talk like humans.

Here,
$p: 5+5=10$ which is true
q: dogs can talk like humans: which is false.

So, ~~form~~ from the truth table of $p \to q$ suggest that the statement is false.

Answer: False

c) If -3 is a negetive number, then birds can fly.

Here, p: -3 is a negetive number which is true

q: birds can fly ~~true~~ which is true.

so, from the truth table of $p \to q$ suggest that the statement is true.

Answer: True

d) If $1+1=2$, then $5+7=12$

Here, p: $1+1=2$ which is true

q: $5+7=12$ which is true

so, from the truth table of $p \to q$ suggest that the statement is True.

Answer: True

Problem 02 |

p	q	$\neg(\neg p \wedge q)$	$(p \vee q) \leftrightarrow \neg(\neg p \wedge q)$	$\neg(p \wedge \neg q)$	$(p \rightarrow q) \leftrightarrow (p \wedge \neg q)$
T	T	T	T	T	T
T	F	T	T	F	T
F	T	F	F	T	T
F	F	T	F	T	T

Problem-3

a) Neither the thunderstorm nor the heavy rain did any damage to the house.

propositions:

p: "Thunderstorm did damage to the house."

q: "The heavy rain did damage to the house."

We can see, both thunderstorm and heavy rain can damage the house. So it defined as $p \vee q$. As it is neither....nor. It becomes the negetion of $p \vee q$.

$\therefore \neg(p \vee q) \equiv \neg p \wedge \neg q$ [Demorgan's Law]

b) If global warming is not controlled, low-lying land will go under water within the next few decades.

propositions:

p: "Global warming is not controlled

q: "Low-lying land will go under water within the next few decades."

∴ with the logical expression it

$$p \to q \equiv \neg p \vee q$$ [Implication defination]

e) Uber/Pathao driver shouldnot drive more than 60 miles per hour nor violate ~~traffic~~ signals, or they will be penalized.

<u>propsitions</u>:

p: "Uber/Patho driver shouldnot drive more ~~the~~ than 60 miles per hour"

q: "Uber/Pathao driver should not violate ~~traffic~~ signals

r: ~~they~~ Uber/Patho driver will be penalized.

Here, p and q connect with nor. so the logical expression is $\neg(p \vee q)$ ~~and~~ with them $\vee$ is connected with nor ∴ Therefore the Logical expresson stands, $\neg(p \vee q) \vee r \equiv (p \vee q) \to r$

[Implication defination]

Problem 04|

$(p \vee q) \wedge (\neg p \vee r) \rightarrow (q \vee r)$

Truth Table:

p	q	r	$\neg p$	$(p \vee q)$	$(\neg p \vee r)$	$(p \vee q) \wedge (\neg p \vee r)$	$(q \vee r)$	$(p \vee q) \wedge (\neg p \vee r) \rightarrow (q \vee r)$
T	T	T	F	T	T	T	T	T
T	T	F	F	T	F	F	T	T
T	F	T	F	T	T	T	T	T
T	F	F	F	T	F	F	F	T
F	T	T	T	T	T	T	T	T
F	T	F	T	T	T	T	T	T
F	F	T	T	F	T	F	T	T
F	F	F	T	F	T	F	F	T

$\therefore$ $(p \wedge q) \wedge (\neg p \vee r) \rightarrow q \vee r$ is a tautology.

Logical Equivalance:

$(p \lor q) \land (\neg p \lor r) \to (q \lor r)$

$\equiv (p \land \neg p) \lor (q \land r) \to (q \lor r)$; Distributive Law

$\equiv F \lor (q \land r) \to (q \lor r)$; Negetion Law

$\equiv (q \land r) \to (q \lor r)$; Identity Law

$\equiv \neg (q \land r) \cancel{\to} \lor (q \lor r)$; Implication defination

$\equiv (\neg q \lor \neg r) \lor (q \lor r)$; Demorgan's Law

$\equiv (\neg q \lor q) \lor (\neg r \lor r)$; Associative Law

$\equiv \cancel{F}\ T \lor T$; Negetion Law

$\equiv T$

$\therefore (p \lor q) \land (\neg p \lor r) \to q \lor r$ is a toutology.

Problem 5

$R(x)$: "Books are in the right place"

$E(x)$: "Books are in excellent condition"

a) Some books are not at the right place

$$\exists x \ \neg R(x)$$

It reads, There exist ~~only~~ atleast one x book that is not at the right place.

b) All books are at the right place and are in excellent condition

$$\forall x (R(x) \wedge E(x))$$

c) Every book is in the right place is in excellent condition

$$\forall x (R(x) \wedge E(x))$$

d) Nothing in the library is at right place and is in excellent condition.

$$\neg \exists x (R(x) \wedge E(x))$$

$$\equiv \forall x \neg (R(x) \wedge E(x))$$

e) One of the book is not in the right place, but it is in exellent condition.

$$\exists x \left(\neg R(x) \wedge E(x)\right)$$

Problem 61

p or q are true and r is false, it denoted as

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