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Course : Discrete Structures

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(CS-1005)

Section : CH-A

Assignment 01.

Q1.

a) $\sim p \wedge (q \vee \sim r)$

p	q	r	$\sim p$	$\sim r$	$q \vee \sim r$	$\sim p \wedge (q \vee \sim r)$
T	T	T	F	F	T	F
T	T	F	F	T	T	F
T	F	T	F	F	F	F
T	F	F	F	T	T	F
F	T	T	T	F	T	T
F	T	F	T	T	T	T
F	F	T	T	F	F	F
F	F	F	T	T	T	T

b) $(p \vee q) \wedge \sim (p \wedge q)$

p	q	$p \vee q$	$p \wedge q$	$\sim (p \wedge q)$	$(p \vee q) \wedge \sim (p \wedge q)$
T	T	T	T	F	F
T	F	T	F	T	T
F	T	T	F	T	T
F	F	F	F	T	F

Q2.

a) $p =$ I forgot my pen

$q =$ My bag

$r =$ My glasses

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

factor out p : $p \vee q \wedge r$

statement: I forgot my pen or my bag and my glasses.

b) $p =$ It is raining $q =$ I have forgotten my umbrella.

$r =$ I have forgotten my hat

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

factor out p : $p \wedge q \vee r$

statement: It is raining and I have forgotten my umbrella or my hat.

c) $p =$ John is attending meeting.

$$\neg \neg p \Rightarrow p$$

Statement: John is attending meeting.

d) $p =$ John is studying $q =$ Mary is working

$r =$ Peter is exercising

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

Already in its simplest form

e) $p =$ John is studying

$q =$ Mary is working

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

statement:

$$\neg p \vee \neg q$$

John is not studying or Mary is not working.

3. a) (John)
If he will not pass exam, then John does not study hard.

b) If the power light is not lit, then the computer is not on.

c) If it will not run, then the car does not have fuel.

d) If I do not ski tomorrow, then it does not snow today.

e) If students do not pass sessional 01, then students do not solve assignment 01.

Q1. b) $(p \rightarrow \sim q) \wedge (p \wedge q)$

p	q	$p \wedge q$	$\sim q$	$p \rightarrow \sim q$	$(p \rightarrow \sim q) \wedge (p \wedge q)$
T	T	T	F	F	F
T	F	F	T	T	F
F	T	F	F	T	F
F	F	F	T	T	F

(contradiction)

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

p	q	$\sim q$	$p \rightarrow \sim q$	$(p \rightarrow \sim q) \wedge q$
T	T	F	F	F
T	F	T	T	F
F	T	F	T	T
F	F	T	T	F

(neither)

4. p = you get more doubles than anyone

q = you will lose

r = you have bought properties.

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

p	q	r	$p \rightarrow q$	$q \rightarrow r$	$p \rightarrow q \vee q \rightarrow r$
T	T	T	T	T	T
T	T	F	T	F	T
T	F	T	F	T	T
T	F	F	F	T	T
F	T	T	T	T	T
F	T	F	T	F	T
F	F	T	T	T	T
F	F	F	T	T	T

So, the following statement is a tautology (valid)

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

$\neg r$
($\neg \wedge \neg r$)

$$\sim (p \vee q) \vee r \quad \text{implication } (\sim p \vee r) \vee (\sim q \vee r)$$

$$(\sim p \wedge \sim q) \vee r \quad \text{de morgan's } (\sim p \vee \sim q) \vee r$$

simplified form

$$\sim p \vee r \vee \sim q \vee r$$

So, not logically equivalent

not equal

Truth Table

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

Q 6.

p = I had pancakes

q = I had waffles

r = I had fruit

s = I had yoghurt

t = I had coffee

$$(\overline{s \rightarrow t}) = \overline{s} + \overline{t}$$

$$\sim (p \vee q) \wedge \sim (r \rightarrow s) \wedge \sim (\sim s \vee \sim t)$$

$$\sim [p \vee q] \wedge \sim [\sim r \vee s] \wedge \sim [\sim s \wedge \sim t]$$

$$(\sim p \wedge \sim q) \wedge (r \wedge \sim s) \wedge (s \wedge t)$$

statement : Aslam did not have pancakes and waffles.

Aslam had fruit but did not ^{have} yoghurt.

Aslam had yoghurt and coffee. (Final answer).

Q 10. p = system is outdated.
 q = initiate an update
 r = notify user.

$$p \rightarrow q$$

$$q \rightarrow r$$

$$\therefore \sim p$$

premises

conclusion

p	q	r	$p \rightarrow q$	$q \rightarrow r$	$\sim p$	
T	T	T	T	T	F	→ invalid
T	T	F	T	F	F	
T	F	T	F	T	F	
T	F	F	F	T	F	
F	T	T	T	T	T	3 critical rows
F	T	F	T	F	T	
F	F	T	T	T	T	
F	F	F	T	T	T	

Argument is invalid.

Q 1. a) $(p \rightarrow q) \wedge \sim p$

p	$\sim p$	q	$p \rightarrow q$	$p \rightarrow q \wedge \sim p$
T	F	T	T	F
T	F	F	F	F
F	T	T	T	T
F	T	F	T	F

so, neither

$$a) p \oplus q^{\wedge r} = p \oplus (q \oplus r)$$

p	q	r	$p \oplus q$	$q \oplus r$	$p \oplus (q \oplus r)$	$(p \oplus q) \oplus r$
T	T	T	F	F	T	T
T	T	F	F	T	F	F
T	F	T	T	T	F	F
T	F	F	T	F	F	F
F	T	T	T	F	T	T
F	T	F	T	T	T	T
F	F	T	F	T	F	F
F	F	F	F	F	F	F

$$b) (p \oplus q) \wedge r = (p \wedge r) \oplus (q \wedge r)$$

p	q	r	$p \oplus q$	$p \wedge r$	$q \wedge r$	$(p \oplus q) \wedge r$	$p \wedge r \oplus q \wedge r$
T	T	T	F	T	T	F	F
T	T	F	T	F	F	F	F
T	F	T	T	T	F	T	T
T	F	F	T	F	F	F	F
F	T	T	T	F	T	F	F
F	T	F	T	F	F	F	F
F	F	T	F	F	F	F	F
F	F	F	F	F	F	F	F

Q9. a) $\square \leftarrow p \wedge q \rightarrow \text{rectangle}$

statement: p is a square and p is not a rectangle.

b) $\sim [p \rightarrow (q \vee r)]$

$\sim [\sim (p \wedge \sim (q \vee r))]$

$\sim [\sim (p \wedge \sim q \wedge \sim r)]$

$p \wedge \sim q \wedge \sim r.$

statement: n is prime and n is not odd and n is not 2.

d) $\sim [p \rightarrow (q \wedge r)]$

$\sim [\sim (p \wedge \sim (q \wedge r))]$

$p \wedge \sim q \vee \sim r$

statement: Tom is Ann's father and Jim is not her uncle or Sue is not her aunt.

c) $\sim [p \rightarrow (q \vee r)]$

$\sim [\sim (p \wedge \sim (q \vee r))]$

$p \wedge \sim q \wedge \sim r$

statement: x is non negative and x is not positive and not zero.

e) $\sim [p \rightarrow (q \wedge r)]$

$p \wedge \sim q \vee \sim r$

statement: n is divisible by 6 and n is not divisible by 2 or 3.