Subject : SECI1013 Discrete Structure

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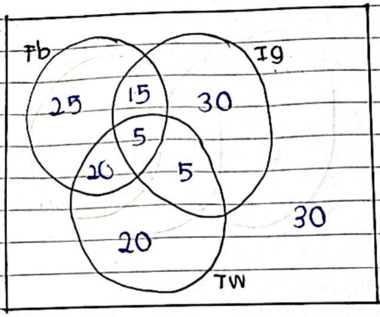
Question 1

a) i)



ii) $n(\xi) - n(FB \cup Ig \cup TW) = 150 - (25 + 15 + 5 + 20 + 20 + 5 + 20)$

$= 30$ students

iii) $(FB \cap Ig) + (Ig \cap TW) + (FB \cap TW) = 15 + 5 + 20$

$= 40$ students

iv) $(FB \cup Ig \cup TW) - FB = 120 - (25 + 15 + 20 + 5)$

$= 120 - 65$

$= 55$ students.

b) i) $A = \{3, 5, 7, 9\}$

$|A| = 4$

$B = \{2, 3, 5, 7\}$

$|B| = 4$

$C = \{3, 6, 9\}$

$|C| = 3$

ii) $|A| = 4$

$= 2^4 - 1$

no of proper subset $= 15$

iii) $|C| \times |B| = 3 \times 4$

$= 12.$

$C \times B = \{(3,2), (3,3), (3,5), (3,7), (6,2), (6,3), (6,5), (6,7), (9,2), (9,3), (9,5), (9,7)\}$

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Question 2

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

Truth table

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

Hence, proven that $\sim(p \vee q) \vee (\sim p \wedge q) \equiv \sim p$.

Logic property law

$$\begin{aligned}\sim(p \vee q) \vee (\sim p \wedge q) &= (\sim p \wedge \sim q) \vee (\sim p \wedge q) \\ &= \sim p \wedge (\sim q \vee q) \\ &= \sim p \wedge U \\ &= \sim p\end{aligned}$$

(b)(i) $(q \wedge r) \rightarrow p$

(b)(ii) $\sim(r \vee q) \rightarrow \sim p$

(b)(iii) $\sim p \rightarrow \sim(r \vee q)$

c) The negation of $\forall x (x^2 + 2x - 3 = 0)$ with the domain of discourse being integers is:

$\exists x (\neg (x^2 + 2x - 3 = 0))$

This statement is TRUE because it means there exists an integer for which the equation $x^2 + 2x - 3 = 0$ is not true, which is true since the equation has solutions for integers.

d) Let domain of discourse = all students in our school

$R(x)$ = can speak Russian

$C(x)$ = know C++

i) $\exists x (R(x) \wedge \neg C(x))$

ii) $\forall x (R(x) \vee C(x))$

iii) $\forall x (\neg R(x) \vee \neg C(x))$

3. For all integers, if $a^2 - 3b$ is even then a is even and b is even.

Assuming the negation of the statement,

There is some integer a and integer b such that $a^2 - 3b$ but neither a nor b is even.

For case a is not even, b is even,

$$a^2 - 3b$$

$$(2m+1)^2 - 3(2n)$$, where m and n are terms to represent integer a and b respectively

$$(2m+1)^2 - 3(2n)$$
$$= 4m^2 + 4m + 1 - 6n$$

Substituting $t = 4m^2 + 4m + 1$, $u = 6n$

$$a^2 - 3b = t - u$$

if t is odd and u is even, the difference between t and u results in an odd number.

Therefore, contradiction has occured when a is odd and b is even.

$\therefore$ The negation of the statement is FALSE, therefore the statement "For all integers, if $a^2 - 3b$ is even then a is even and b is even" is TRUE.