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UTM Universiti Teknologi Malaysia

Programme : SECPH - Bachelor of Computer Science (Data Engineering) with
Honours

Semester : 2023 / 24 - 1

Section : Section 02

Course Name : Discrete Structure

Course Code : SEC11013

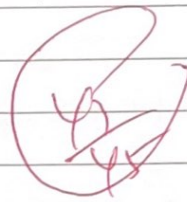
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Assignment Topic : Assignment 1

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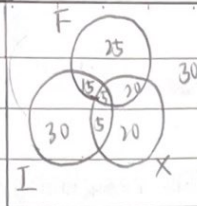
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Assignment 1

1. (a) (i)



F: The students that using Facebook

I: The students that using Instagram

X: The students that using Twitter.

$$(ii) 150 - 25 - 20 - 20 - 15 - 5 - 5 - 30 = 30 \quad \therefore (F \cup I \cup X)' = 30 \text{ students}$$

$$(iii) 15 + 20 + 5 = 40 \quad \therefore (F \cap I \cap X)' \cap ((F \cap I) \cup (F \cap X) \cup (X \cap I)) = 40 \text{ students}$$

$$(iv) 30 + 5 + 20 = 55 \quad \therefore (I \cup X) \cap F' = 55 \text{ students}$$

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

$$(i) |A| = 4$$

$$|B| = 4$$

$$|C| = 3$$

$$(ii) |P(A)| = 2^n = 2^4 = 16$$

 \therefore Proper subsets of $A = 16 - 1$

$$= 15 //$$

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

2. (a)

p	q	$(p \vee q)$	$\sim(p \vee q)$	$\sim p$	$\sim p \wedge q$	$\sim(p \vee q) \vee (\sim p \wedge q)$	$\therefore \sim(p \vee q) \vee (\sim p \wedge q)$
T	T	T	F	F	F	F	$\equiv \sim p$ (verified)
T	F	T	F	F	F	F	
F	T	T	F	T	T	T	
F	F	F	T	T	F	T	

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

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

 \rightarrow De-Morgan's laws

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

 \rightarrow Distributive laws

$$= \sim p \wedge 1$$

 \rightarrow Complement laws

$$= \sim p \text{ (shown)}$$

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

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

$$\equiv \neg r \wedge \neg q \rightarrow \neg p$$

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

$$\equiv \neg p \rightarrow \neg r \wedge \neg q$$

(c) $\forall x (x^2 + 2x - 3 = 0)$

Negation: $\sim (\forall x (x^2 + 2x - 3 = 0)) = \exists x \neg (x^2 + 2x - 3 = 0)$

There is some $x^2 + 2x - 3 \neq 0$

When $x=6$, $6^2 + 2(6) - 3 = 45 (\neq 0)$

\therefore The resulting proposition is TRUE.

(d) $RC(x)$: Students who can speak Russian

$CC(x)$: Students who know C++

x : Students at school

(i) $\exists x (RC(x) \wedge \sim CC(x))$

(ii) $\forall x (RC(x) \vee CC(x))$

(iii) $\forall x (\sim RC(x) \wedge \sim CC(x))$

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

$P(x)$: $a^2 - 3b$ is even; $Q(x)$: a and b is even

$\forall x (P(x) \rightarrow Q(x))$

$\forall x \neg (P(x) \rightarrow Q(x)) \equiv \forall x \neg Q(x) \rightarrow \neg P(x)$

For all integers, if a or b is odd, then $a^2 - 3b$ is odd.

Case 1 (a is odd, b is even) let $a=2n+1$, $b=2k$

$a^2 - 3b = (2n+1)^2 - 3(2k)$

$= 4n^2 + 4n + 1 - 6k$

$= 2(2n^2 + 2n - 3k) + 1$ let $m = 2n^2 + 2n - 3k$

$= 2m + 1$ (odd)

Case 2 (a is even, b is odd) let $a=2n$, $b=2n+1$

$a^2 - 3b = (2n)^2 - 3(2n+1)$

$= 4n^2 - 6n - 3$

$= 2(2n^2 - 3n) - 3$ let $m = 2n^2 - 3n$

$= 2m - 3$ (odd)

Case 3 (a is odd, b is odd) let $a=2n+1$, $b=2n+1$

$a^2 - 3b = (2n+1)^2 - 3(2n+1)$

$= 4n^2 + 2n + 1 - 6n - 3$

$= 4n^2 - 4n - 2$

$= 2(2n^2 - 2n - 1)$

$= 2m$ (even)

\therefore Since $\neg P(x)$ is false in case 3, thus the statement " $\forall x (P(x) \rightarrow Q(x))$ "

is false.