SCHOOL OF COMPUTING
Faculty of Engineering

SECI1013 DISCRETE STRUCTURE

Assignment 1

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Section 07

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Ans to the Q-1

Given,

$R = (-\alpha, \alpha)$

$A = \{x \in R \mid 0 < x \leq 2\}$

$B = \{x \in R \mid 1 \leq x < 4\}$

$C = \{x \in R \mid 3 \leq x < 9\}$

a) $A \cup C = \{x \in R \mid 0 < x \leq 2 \text{ or } 3 \leq x < 9\}$

b) $(A \cup B)' = R - (A \cup B)$

$= \{x \in R \mid x \in (-\infty, 1) \text{ or } x \in (3, \infty)\}$

$= \{x \in R \mid x \leq 0 \text{ or } x \geq 4\}$

c) $A' \cup B'$

$A' = R - A$

$= \{x \in R \mid x \in (-\infty, 1) \text{ or } x \in (2, \infty)\}$

$B' = R - B$

$= \{x \in R \mid x \in (-\infty, 1) \text{ or } x \in (3, \infty)\}$

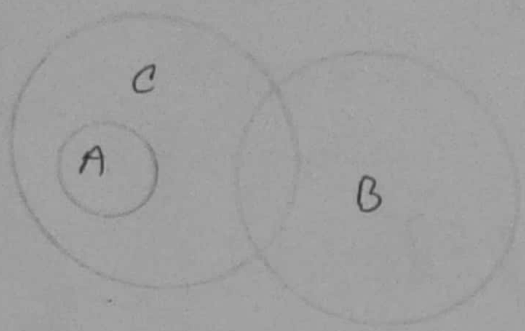
So, $A' \cup B' = \{x \in R \mid x \in (-\infty, 1) \text{ or } x \in (2, \infty)\}$

$= \{x \in R \mid x < 1 \text{ or } x > 2\}$

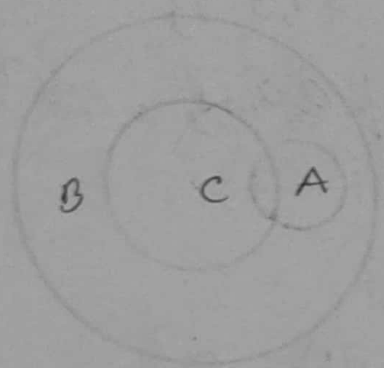
Ans to the Q-2

a) $A \cap B = \emptyset$, $A \subseteq C$, $C \cap B = \emptyset$

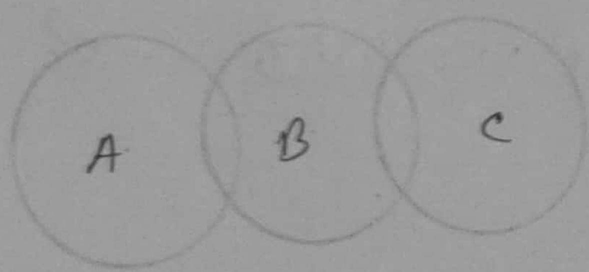
Venn diagrams



b) $A \subseteq B$, $C \subseteq B$, $A \cap C \neq \phi$



c) $A \cap B = \phi$, $B \cap C \neq \phi$, $A \cap C = \phi$, $A \not\subset B$, $C \subset B$



Ans to the Q-3

Given,

$A = \{-1, 1, 2, 4\}$ and $B = \{1, 2\}$

So,

$A \times B = \{(-1,1), (-1,2), (1,1), (1,2), (2,1), (2,2), (4,1), (4,2)\}$

Now, condition is

For all $(x,y) \in A \times B$, $xSy \leftrightarrow |x| = |y|$

For all $(x,y) \in A \times B$, $xTy \leftrightarrow x-y$ is even

So $S = \{(-1,1), (1,1), (2,2)\}$

$T = \{(-1,1), (1,1), (2,2), (4,2)\}$

$S \cap T = \{(-1,1), (1,1), (2,2)\}$

$S \cup T = \{(-1,1), (1,1), (2,2), (4,2)\}$

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4 $\neg((\neg p \wedge q) \vee (\neg p \wedge \neg q)) \vee (p \wedge q) \equiv p$

From LHS :

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

$\equiv \neg((\neg p \wedge q) \vee (\neg(p \vee q))) \vee (p \wedge q)$	De Morgan's law
$\equiv (\neg(\neg p \wedge q) \wedge (\neg(\neg(p \vee q)))) \vee (p \wedge q)$	De Morgan's law
$\equiv (\neg(\neg p \wedge q) \wedge (p \vee q)) \vee (p \wedge q)$	Double Negation law
$\equiv (((\neg(\neg p)) \vee \neg q) \wedge (p \vee q)) \vee (p \wedge q)$	De Morgan's Law
$\equiv ((p \vee \neg q) \wedge (p \vee q)) \vee (p \wedge q)$	Double Negation Law
$\equiv (p \vee (\neg q \wedge q)) \vee (p \wedge q)$	Distributive Law
$\equiv (p \vee F) \vee (p \wedge q)$	Negation Laws
$\equiv p \vee (p \wedge q)$	Identity Law
$\equiv p$ # shown	Absorption Law

5.

$R_1 = \{(x, y) \mid x + y \leq 6\}$ and $R_1 : x \to y$

$R_1 = \{(1,5), (1,4), (1,3), (1,2), (1,1), (2,4), (2,3), (2,2), (2,1), (3,3), (3,2), (3,1), (4,2), (4,1), (5,1)\}$

a.

$$A_1 = \begin{array}{c|c} & \begin{matrix} 1 & 2 & 3 & 4 & 5 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{matrix} & \begin{bmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

$R_2 = \{(y, z) \mid y = z + 1\}$
and $R_2 : y \to z$, $y, z = \{1, 2, 3, 4, 5\}$

$R_2 = \{(2,1), (3,1), (3,2), (4,1), (4,2), (4,3), (5,1), (5,2), (5,3), (5,4)\}$

b.

$$\begin{array}{c|c} & \begin{matrix} 1 & 2 & 3 & 4 & 5 \end{matrix} \\ \begin{matrix} 1 \\ 2 \\ 3 \\ 4 \\ 5 \end{matrix} & \begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 \end{bmatrix} \end{array}$$

c. R_1 is not reflexive
R_1 is symmetric
R_1 is not transitive
R_1 is not equivalence relation

D. R_2 is irreflexive
R_2 is antisymmetric
R_2 is not transitive
R_2 is not a Partial order relation

6.

a.

$$R_1 \cup R_2 = R_1 \vee R_2$$

$$= \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix}$$

b.

$$R_1 \cap R_2 = R_1 \wedge R_2$$

$$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{bmatrix}$$

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7 $f: R \to R$ and $g: R \to R$

If $f(x) = x$ and $g(x) = x$, then

$(f+g)(x) = x + x$

$(f+g)(x) = 2x$

Assume $(f+g)(x_1) = (f+g)(x_2)$

$2x_1 = 2x_2$

$x_1 = x_2$

Since we have shown if $(f+g)(x_1) = (f+g)(x_2)$ then $x_1 = x_2$.

Therefore, $f+g$ is one-to-one.

8 n = number of stairs

C_n = number of different ways to climb the staircase.

for each integer $n \geq 1$:

if $(n = 1)$; only one way to climb the staircase which is by taking one stair at a time.

$\therefore C_1 = 1$

if $(n = 2)$, we can either taking one stair one by one, or take two at a time.

$\therefore C_2 = 2$

if $(n \geq 3)$, we need to take a combination of one- or two-stair increments.

$\therefore C_n = C_{n-1} + C_{n-2}$, $n \geq 3$ with initial condition $C_0 = 1$

9 $t_0 = 0$, $t_1 = 1$, $t_2 = 1$,

$t_n = t_{n-1} + t_{n-2} + t_{n-3}$ for all $n \geq 3$

a) $t_3 = t_2 + t_1 + t_0 = 1 + 1 + 0 = 2$

$t_4 = t_3 + t_2 + t_1 = 2 + 1 + 1 = 4$

$t_5 = t_4 + t_3 + t_2 = 4 + 2 + 1 = 7$

$t_6 = t_5 + t_4 + t_3 = 7 + 4 + 2 = 13$

$t_7 = t_6 + t_5 + t_4 = 13 + 7 + 4 = 24$

$\therefore t_7 = 24$

b)
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Input : n
Output : f(n)
f(n)
{ if (n=0)
        return 0
  if (n=1 or n=2)
        return 1
  return  f(n-1) + f(n-2) + f(n-3)
}
```