DISCRETE MATHEMATICS ASSIGNMENT

ELEMENT 1

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Question 1

(a) State the converse, contrapositive and the inverse of the following conditional statement:

P → Q

"If it is sunny today, then I will go for a run".

Converse:

Q → P

If I will go for a run, then it is sunny today.

Contrapositive:

¬Q → ¬P

If I don't go for a run, then it is not sunny today.

Inverse:

¬P → ¬Q

If it's not sunny today, I will not go for a run.

(b) Write the if-then form, the converse, the inverse and the contrapositive of the following conditional statement, identifying whether each statement is true or false:

"Saxophone players are musicians".

We let P be "Saxophone players" and Q be "musicians.

If-then form

If you are a Saxophone player, then you are a musician.

P	Q	P → Q
T	T	T
T	F	F
F	T	T
F	F	T

Converse

If you are a musician, then you are a saxophone player

Q	P	Q → P
T	T	T
T	F	F
F	T	T
F	F	T

Contrapositive

If you are not a musician, then you are not a saxophone player.

P	Q		¬P	¬Q	¬P → ¬Q
T	T		F	F	T
T	F		F	T	T
F	T		T	F	F
F	F		T	T	T

Inverse

If you are not a saxophone player, then you are not a musician.

Q	P		¬Q	¬P	¬Q → ¬P
T	T		F	F	T
T	F		F	T	T
F	T		T	F	F
F	F		T	T	T

(c)

(i)   01 1011 0111

       11 0011 1010

OR

01 1011 0111

11 0011 1011

----

11 1011 1111

AND

01 1011 0111

11 0011 1010

----

01 0011 0010

XOR

01 1011 0111

11 0011 1010

----

10 1000 1101

(ii)   101 1100

   100 0111

   OR

   101 1100

   100 0111

   ----

   101 1111

   AND

   101 1100

   100 0111

   ----

   100 1100

   XOR

   101 1100

   100 0111

   ----

   001 1011

Question 2 [12 marks]

Use truth values to verify the following Logical Equivalence Laws:

(a) (i) First Associative law: (P v Q) v R ≡ P v (Q v R)

P	Q	R	P v Q	Q v R	(P v Q) v R	P v (Q v R)
T	T	T	T	T	T	T
T	T	F	T	T	T	T
T	F	T	T	T	T	T
T	F	F	T	F	T	T
F	T	T	T	T	T	T
F	T	F	T	T	T	T
F	F	T	F	T	T	T
F	F	F	F	F	F	F

(ii) First Absorption law:

P v (P ^ Q) ≡ P

P	Q	P ^ Q	P v (P ^ Q)
T	T	T	T
T	F	F	T
F	T	F	F
F	F	F	F

(b) Let R be a relation on the non-empty set A. By choosing a suitable set A and relation R, determine if your relation R has the relevant properties: reflexive, symmetric, antisymmetric and transitive. If your chosen relation fails to have a property, give an example showing why it fails in this case.

A = {1,2,3,4}

R = {(a, b) a ∈ A, b ∈ A, a ≥ b}

R = {(1,1),(2,1),(2,2),(3,1),(3,2),(3,3),(4,1),(4,2),(4,3),(4,4)}

It's reflexive, due to the fact that (1,1),(2,2),(3,3),(4,4) exist in the data set. If any one of the 4 was missing, the data set wouldn't be reflexive.

Antisymmetric

If 1,2 and 2,1 were in the data set, it would have been symmetric, so it's antisymmetric.

Not transitive.

If x = 1, y = 2 and z = 3

However due to the set being a greater that or equal to b, this is not the case as 1,2 and 2,3 are not in the data set, so 1,3 isn't in the set as well.

Question 3

(a) Use logical equivalences to establish the following set of equalities, employing also set builder notation:

A U (B U C) = (A U B) U C

{A|A = 1,3,5}

{B|B = 2,4,6}

{C|C= 7,8}

The union of B and C equals :

B U C = {2,4,6,7,8}

The union of (B U C) and union of A equals:

A U (B U C) = {1,2,3,4,5,6,7,8}

The union of A and B equals:

A U B = {1,2,3,4,5,6}

The union of (A U B) and union of C equals:

(A U B) U C = {1,2,3,4,5,6,7,8}

$(A \cap B) \cup (A \cap \bar{B}) = A$

$\{A|A = \{1,2,3\}$

$\{B|B = \{2,4,5,6\}$

$A \cap B = \{2\}$

$A \cap \bar{B} = \{1,2,3\}$
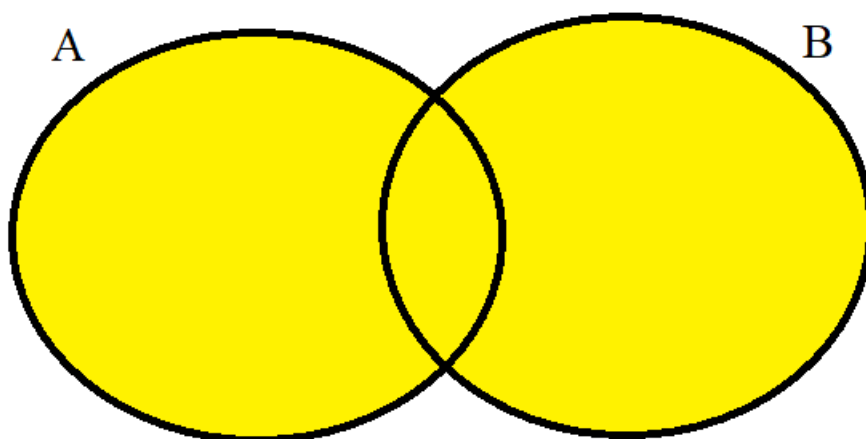
$\mathbf{(A \cap B) \cup (A \cap B) = \{1,2,3\}}$

$\mathbf{A = \{1,2,3\}}$

They're equal

(b)Using Venn
diagrams, show that:

$\overline{(A \cap B)} = \bar{A} \cup \bar{B}$

(c) Using a Venn diagram and by using a suitable example for your chosen non-empty

and different A, B, C sets, show that:

$(A - B) \cup (C - B) \neq A - (B \cup C)$
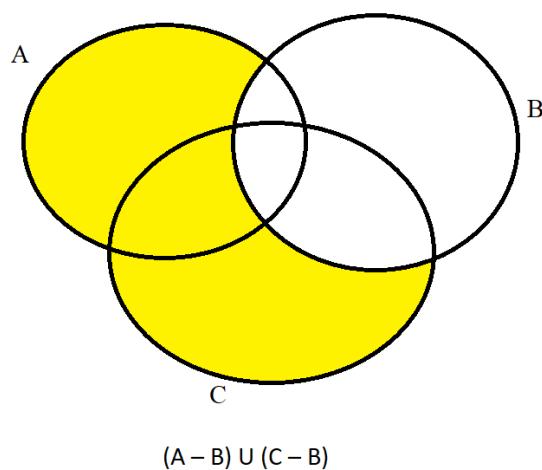

$\{A | A = \{1,2,3\}$

$\{B | B = \{2,4,5,6\}$

$\{C | C = \{5,6,7,8\}$

$(A - B) \cup (C - B)$

$A - B = \{1,3\}$

$C - B = \{7,8\}$

$(A - B) \cup (C - B) = \{1,3,7,8\}$

$(A - B) \cup (C - B)$

A – (B U C)

B U C = {2,4,5,6,7,8}

A – (B U C) = {1,3}

A

B

C

A – (B U C)