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**AUTOMATA THEORY ASSIGNMENT 1**

**Question one.**

Construct truth tables for the following propositions

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P | Q | ~P | ~Q | ~P ^ ~Q |
| T | T | F | F | F |
| T | F | F | T | F |
| F | T | F | F | F |
| F | F | T | T | T |

ii.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P | Q | ~P | ~P ^ Q | ~(~P ^ Q) |
| T | T | F | F | T |
| T | F | F | F | T |
| F | T | T | T | F |
| F | F | T | F | T |

iii.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| P | Q | ~P | ~Q | ~P v ~Q | ~(~P v ~Q) |
| T | T | F | F | F | T |
| T | F | F | T | T | F |
| F | T | T | F | T | F |
| F | F | T | T | T | F |

iv.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P | ~P | Q | ~P ^ Q | P v (~P ^ Q) |
| T | F | T | F | T |
| T | F | F | F | T |
| F | T | T | T | T |
| F | T | F | F | F |

**QUESTION TWO**

2. (a) Let set A = {1, 2, 3}; Set B = {4, 5, 6} and Set C = {7, 8, 9}

Proof the above properties of sets (laws) using the sets

➢ Independent law

• A∪A=A

• A∩A=A

A={1,2,3} The union of the A and A

remain the same and so does

the intersection.

➢ Commutative law

• A∪B= B∪A

A∪B={1,2,3,4,5,6}

B∪A={1,2,3,4,5,6}

• A∩B= B∩A

A∩B= Empty set

B∩A= Empty set

➢ Associative Law

• (A∪B)∪C=A∪(B∪C)

(A∪B)∪C=(1,2,3,4,5,6,7,8

,9)

A∪(B∪C)=(1,2,3,4,5,6,7,

8,9)

• (A∩B)∩C=A∩(B∩C)

(A∩B)∩C= Empty set

A∩(B∩C)= Empty set

➢ Distributive law

• (A∪B) ∩C = (A∩C) ∪(B∩C)

(A∪B) ∩C= Empty set

(A∩C) ∪(B∩C)= Empty set

• (A∩B) ∪C = (A∪C) ∩

(B∪C)

(A∩B) ∪C = {7,8,9}

➢ Absorption Law (A∪B) ∩ A = A

A={1,2,3} which is equals to

(A∪B) ∩ A which is

{1,2,3,4,5,6}n{123}

={1,2,3}

**QUESTION THREE**

|  |  |  |
| --- | --- | --- |
| P | ~P | P v ~P |
| T | F | T |
| F | T | T |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Q | R | Q^R | ~(Q^R) | (Q^R)v~(Q^R) |
| T | T | T | F | T |
| T | F | F | T | T |
| F | T | F | T | T |
| F | F | F | T | T |

The propositions of the last tables in each compound statement has all true values so it is correct to say that this a tautology.

**QUESTION FIVE**

**C**onstruct a truth table for each of the following statement

I.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| P | Q | P → Q | Q^(P →Q) | Q^(P →Q) →P |
| T | T | T | T | T |
| T | F | F | F | T |
| F | T | T | T | F |
| F | F | T | F | T |

**II.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| P | Q | P^Q | ~(P^Q) | ~P | ~Q | ~Pv~Q | ~(pΛq)↔(~pV~q) |
| T | T | T | F | F | F | F | T |
| T | F | F | T | F | T | T | T |
| F | T | F | T | T | F | T | T |
| F | F | F | T | T | T | T | T |

**QUESTION FOUR**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| P | Q | R | P → Q | Q → R | P → Q  ^ Q → R | P → Q  ^(P → Q  ^ Q → R) |
| T | T | T | T | T | T | T |
| T | T | F | T | F | F | T |
| T | F | T | F | T | F | T |
| T | F | F | F | T | F | T |
| F | T | T | T | T | T | T |
| F | T | F | T | F | F | T |
| F | F | T | T | T | T | T |
| F | F | F | T | T | T | T |

The statement is a tautology.

**QUESTION SIX**

**For any alphabet ∑, the set of all**

**strings over ∑ is denoted by ∑\*,**

**suppose ∑ is in the two symbol**

**alphabet {a, b}, what are the possible**

**subsets of ∑\* (5 Marks)**

The possible sets for {a,b} \* are:

(e,a,ab,aa,aab,aabb,b,ba,bb,bba,bbaa...)