**Course: Discrete Structure**

**Program: BS (SE)**

**Instructor: Muhammad Abrar Khan**

**Examination: Midterm Assignment**

**Total Marks: 30**

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**Note:** Attempt all questions. Use examples and diagrams where necessary.

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# BS (SE)

**Q.1**

Which of the following are propositions?

***Proposition is a declarative sentence, which is either true or false, but not both at the same time.***

1. Buy Premium Bonds!
2. ***The Apple Macintosh is a 16 bit computer. (proposition)***
3. ***There is a largest even number. (proposition)***
4. Why are we here?
5. ***8 + 7 = 13 (proposition)***
6. a + b = 13

**Q.2**

p is "x < 50"; q is "x > 40".

Write as simply as you can:

(a) ¬p

(b) ¬q

(c) p ˄ q

***(d) p ∨ q (correct answer)***

(e) ¬p ˄ q

(f) ¬p ˄¬q

**Q.3**

In each part of this question a proposition p is defined. Which of the statements that follow the definition correspond to the proposition ¬p? (There may be more than one correct answer.)

(a)

p is "Some people like Maths".

(a) "Some people dislike Maths"

***(b) "Everybody dislikes Maths" (correct answer)***

(c) "Everybody likes Maths"

b)

p is "The answer is either 2 or 3".

***(a) "Neither 2 nor 3 is the answer" (correct answer)***

(b) "The answer is not 2 or it is not 3"

***(c) "The answer is not 2 and it is not 3" (also correct)***

c)

p is "All people in my class are tall and thin".

(a) "Someone in my class is short and fat"

(b) "No-one in my class is tall and thin"

***(c) "Someone in my class is short or fat" (correct answer)***

**Q.4**

Construct truth tables for:

1. ¬p ∨ ¬q
2. q˄ (¬p ∨ q)
3. p ˄ (q ∨ r)
4. (p˄ q) ∨ r

# ~p v ~q

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **p** | **q** | **~p** | **~q** | **~p v ~q** |
| T | T | F | F | F |
| T | F | F | T | T |
| F | T | T | F | T |
| F | F | T | T | T |

# q ^(~p v q)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **p** | **q** | **~p** | **(~p v q)** | **q^(~p v q)** |
| T | T | F | T | T |
| T | F | F | F | F |
| F | T | T | T | T |
| F | F | T | T | F |

# p^(q v r)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **p** | **q** | **r** | **(q v r)** | **p ^(q v r)** |
| T | T | T | T | T |
| T | F | T | T | T |
| T | T | F | T | T |
| T | F | F | F | F |
| F | T | T | T | F |
| F | F | T | T | F |
| F | T | F | T | F |
| F | T | F | F | F |

# (p ^ q) v r

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | r | (p^q) | (p^q) v r |
| T | T | T | T | T |
| T | F | T | F | T |
| T | T | F | T | T |
| T | F | F | F | F |
| F | T | T | F | T |
| F | F | T | F | T |
| F | T | F | F | F |
| F | F | F | F | F |

**Q.5**

Use truth tables to show that:

¬ ((p ∨ ¬q) ∨ (r ˄ (p ∨ ¬q))) ≡ ¬p ˄ q

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | r | ~p | ~q | (p v ~q) | r^(pv~q) | (pv~q)v(r^(pv~q)) | ~((pv~q)v(r^(pv~q))) | ~p^q |
| T | T | T | F | F | T | T | T | **F** | **F** |
| T | T | F | F | F | T | F | T | **F** | **F** |
| T | F | T | F | T | T | T | T | **F** | **F** |
| T | F | F | F | T | T | F | T | **F** | **F** |
| F | T | T | T | F | F | F | F | **T** | **T** |
| F | T | F | T | F | F | F | F | **T** | **T** |
| F | F | T | T | T | T | T | T | **F** | **F** |
| F | F | F | T | T | T | F | T | **F** | **F** |

## Hence it is proved that ¬ ((p ∨ ¬q) ∨ (r ˄ (p ∨ ¬q))) is equivalent to ~p^q.

**Q.6**

Use the laws of logical propositions to prove that:

(z ˄ w) ∨ (¬z w) ∨ (z ˄ ¬w) ≡ z ∨ w

State carefully which law you are using at each stage.

PROOF:

(z ˄ w) ∨ (¬z w) ∨ (z ˄ ¬w) ≡ z ∨ w

## (z ^ w) v (z ^ ~w) v (~z ^w) commutative law

(z ^ (w v ~w)) v (~z ^ w) distributive law

(z ^ t) v ( ~z ^ w) negation law

Z v ( ~z ^ w) identity law

(z v ~z) ^ ( z v w ) distributive law

t ^ ( z v w) negation law

(z v w) ^ t commutative law

Z v ( w ^ t ) associative law

Z v W identity law