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Section----- (B)
Department----- BS Software Engineering
Semester----- 2nd
Subject----- Discrete structure
Examination----- Mid-Term
Date----- April 14th, 2020
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Note: Attempt all questions. Use examples and diagrams where necessary.

Q.1

Which of the following are propositions?

- a) Buy Premium Bonds!
- b) The Apple Macintosh is a 16 bit computer.
- c) There is a largest even number.
- d) Why are we here?
- e) $8 + 7 = 13$
- f) $a + b = 13$

Answer : b) , c) and e) are propositions

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Q.2

p is " $x < 50$ "; q is " $x > 40$ ".

Write as simply as you can:

- (a) $\neg p$ → "X is not less than 50" or " $X \geq 50$ "
 - (b) $\neg q$ → "X is not greater than 40" or " $X \leq 40$ "
 - (c) $p \wedge q$ → "X is less than 50 and greater than 40"
 - (d) $p \vee q$ → "X is less than 50 or greater than 40"
 - (e) $\neg p \wedge q$ → "X is not less than 50 but less than 40"
 - (f) $\neg p \wedge \neg q$ → "X is not less than 50 and 40"
- =====

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 $\neg p$? (There may be more than one correct answer.)

(a)

p is "Some people like Maths".

(a) "Some people dislike Maths"

(b) "Everybody dislikes Maths"

(c) "Everybody likes Maths"

Answer : (a) "Some people dislike Maths"

b)

p is "The answer is either 2 or 3".

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

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

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

Answer : (a) "Neither 2 nor 3 is the answer" (c) "The answer is not 2 and it is not 3"

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"

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

Q.4

Construct truth tables for:

a) $\neg p \vee \neg q$

p	q	$\neg p$	$\neg q$	$\neg p \vee \neg q$
T	T	F	F	F
T	F	F	T	T
F	T	T	F	T
F	F	T	T	T

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

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

c) $p \wedge (q \vee r)$

p	q	r	(q ∨ r)	p ∧ (q ∨ r)
T	T	T	T	T
T	T	F	T	T
T	F	T	T	T
T	F	F	F	F
F	T	T	T	F
F	T	F	T	F
F	F	T	T	F
F	F	F	F	F

d) $(p \wedge q) \vee r$

p	q	r	(p ∧ q)	(p ∧ q) ∨ r
T	T	T	T	T
T	T	F	T	T
T	F	T	F	T
T	F	F	F	F
F	T	T	F	T
F	T	F	F	F
F	F	T	F	T
F	F	F	F	F

Q.5

Use truth tables to show that:

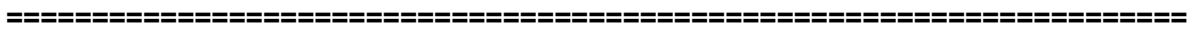
$$\neg((p \vee \neg q) \vee (r \wedge (p \vee \neg q))) \equiv \neg p \wedge q$$

L.H.S $\neg((p \vee \neg q) \vee (r \wedge (p \vee \neg q)))$

p	q	r	$\neg p$	$\neg q$	$\neg r$	$(p \vee \neg q)$	$\neg(p \vee \neg q)$	$(r \wedge (p \vee \neg q))$	$\neg((p \vee \neg q) \vee (r \wedge (p \vee \neg q)))$
T	T	T	F	F	F	T	F	T	T
T	T	F	F	F	T	T	F	F	F
T	F	T	F	T	F	T	F	T	T
T	F	F	F	T	T	T	F	F	F
F	T	T	T	F	F	F	T	F	T
F	T	F	T	F	T	F	T	F	T
F	F	T	T	T	F	T	F	T	T
F	F	F	T	T	T	T	F	F	F

R.H.S $\neg p \wedge q$

p	q	$\neg p$	$\neg p \wedge q$
T	T	F	F
T	F	F	F
F	T	T	T
F	F	T	F

**Q.6**

Use the laws of logical propositions to prove that:

$$(z \wedge w) \vee (\neg z \wedge w) \vee (z \wedge \neg w) \equiv z \vee w$$

State carefully which law you are using at each stage.

$$\begin{aligned} \text{Answer : } (z \wedge w) \vee (\neg z \wedge w) \vee (z \wedge \neg w) &= (z \wedge w) \vee (z \wedge \neg w) \vee (\neg z \wedge w) && \text{Communicative Law} \\ &= (z \wedge (w \vee \neg w)) \vee (\neg z \wedge w) && \text{Distributive Law} \\ &= (z \wedge T) \vee (\neg z \wedge w) && \text{Complement Law} \\ &= z \vee (\neg z \wedge w) && \text{Identity Law} \\ &= (z \vee \neg z) \wedge (z \vee w) && \text{Distributive Law} \\ &= T \wedge (z \vee w) && \text{Complement Law} \\ &= (z \vee w) \wedge T && \text{Commutative Law} \\ &= z \vee w && \text{Identity Law} \end{aligned}$$

THANK YOU MY RESPECTABLE TEACHER...!!