CS & IT ENGINEERING

DISCRETE MATHS

Mathematical Logic

Lecture No. 2

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TOPICS

01 Logical equivalence

02 Inference rule

03 Type 2

Type-2 : (logical equivalence / $\equiv$)

$p \wedge p \equiv p$
$p \vee p \equiv p.$

$p \wedge T \equiv p$
$p \vee F \equiv p$

$p \vee T \equiv T.$
$p \wedge F \equiv F.$

$$\begin{cases} p \vee q = q \vee p \\ p \wedge q = q \wedge p \end{cases}$$

$$\begin{cases} p \wedge (q \wedge R) \equiv (p \wedge q) \wedge R. \\ p \vee (q \vee R) \equiv (p \vee q) \vee R \end{cases}$$

logic	set	digital.
$\wedge$	$\cap$	$\cdot$
$\vee$	$\cup$	$+$
T	$\mathcal{U}$	1
F	$\emptyset$	0

$$\boxed{p \wedge (q \vee R)} \equiv (p \wedge q) \vee (p \wedge R)$$

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

$$p \vee (q \wedge R) \equiv (p \vee q) \wedge (p \vee R)$$

Absorption:

$$a \vee (a \wedge b) = a.$$

$a = T$

$$T \vee (T \wedge \_\_) \equiv T$$

$a = F$

$$F \vee \underbrace{(F \wedge \_\_)}_{F} \equiv F$$

$$a \wedge (a \vee b) = a.$$

$a = T$

$$T \wedge (T \vee \_\_) \equiv T$$

$a = F$

$$a \wedge (a \vee b)$$

$$F \wedge (F \vee \_\_) \equiv F$$

$a \vee (a \wedge b) = a.$

$a \wedge (a \vee b) \equiv a.$

$(\boxed{a \to b}) \vee ((\boxed{a \to b}) \wedge (c \to d)) \equiv a \to b.$

$\boxed{} \wedge \left(\boxed{} \vee \boxed{} \right) \quad \boxed{}$

$$p \to q \equiv \neg p \vee q$$

$$p \to q \equiv \neg q \to \neg p$$

God's Rule

$$\neg(a \vee b) \equiv \neg a \wedge \neg b$$

$$\neg(a \wedge b) \equiv \neg a \vee \neg b$$

$$(p \to q) \land (p \to R) \equiv p \to (q \land R)$$

$$(\boxed{\neg p \lor} q) \land (\boxed{\neg p \lor} R)$$

$$\neg p \lor (q \land R)$$

$$p \to (q \land R)$$

$$(P \to R) \land (Q \to R) \equiv (P \lor Q) \to R.$$

$$(\neg P \boxed{\lor R}) \land (\neg Q \boxed{\lor R})$$

$$(\neg P \land \neg Q) \lor R$$

Demorgan's.

$$\neg (P \lor Q) \lor R$$

God's Rule.

$$\downarrow$$

$$(P \lor Q) \to R.$$

$$\begin{cases} (P \to q) \land (P \to R) \equiv P \to (q \land R) \\ (P \to R) \land (Q \to R) \equiv (P \lor Q) \to R \end{cases}$$

$$\begin{cases} (P \to Q) \lor (P \to R) \equiv P \to (Q \lor R) \\ (P \to R) \lor (Q \to R) \equiv (P \land Q) \to R. \end{cases}$$

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

$$P \leftrightarrow Q \equiv (p \to q) \wedge (q \to p)$$

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

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

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

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

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

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

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

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

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

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

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

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

$$\equiv \neg q \wedge \neg p$$

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

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

$$F \vee (p \wedge q) \equiv p \wedge q$$

The Simplest form of $(p\wedge(\sim r \vee \boxed{q \vee \sim q}))\vee((r \vee t \vee \sim r)\wedge\sim q)$ is

(a) $p\wedge\sim q$

(b) $p\vee\sim q$

(c) t

(d) $(p\rightarrow\sim q)$

$p \wedge (\neg R \vee T)$

$p \wedge T$

$\downarrow$

P

$\vee$

$((r \vee \neg R) \vee t) \wedge \neg q$

$(T \vee t) \wedge \neg q$

$\downarrow$

$T \wedge \neg q$

$\downarrow$

$\neg q$

The Simplest form of

$\boxed{(p \vee (p \wedge q)} \vee (p \wedge q \wedge \sim r)) \wedge ((p \wedge r \wedge t) \vee t)$ is

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

$p \wedge t$

(a) $p \wedge t$

(b) $q \wedge t$

(c) $p \wedge r$

(d) $p \wedge q$

Which one of the following is NOT equivalent to $p \leftrightarrow q$?

(GATE-15-Set1)

(a) $(\sim p \vee q) \wedge (p \vee \sim q)$

(b) $(\sim p \vee q) \wedge (q \rightarrow p)$

(c) $(\sim p \wedge q) \vee (p \wedge \sim q)$ ✗

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

P and Q are two propositions. Which of the following logical expressions are equivalent?

I. $P \vee \sim Q$

II. $\sim(\sim P \wedge Q)$

III. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$

IV. $(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge Q)$

(GATE-08)

(a) Only I and II

(b) Only I, II and III

(c) Only I, II and IV

(d) All of I, II, III and IV

I. $p \vee \neg Q$

II. $\neg(\neg p \wedge Q) \equiv p \vee \neg Q$

$\mathrm{I} = \mathrm{II}$

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

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

$(p \wedge T) \vee$

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

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

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

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

$(p \vee \neg q)$

$$\neg[\neg[(p \vee q) \wedge r] \vee \neg q],$$

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

Simplify above expression.

i) $p \to (q \wedge r) \Leftrightarrow (p \to q) \wedge (p \to r)$

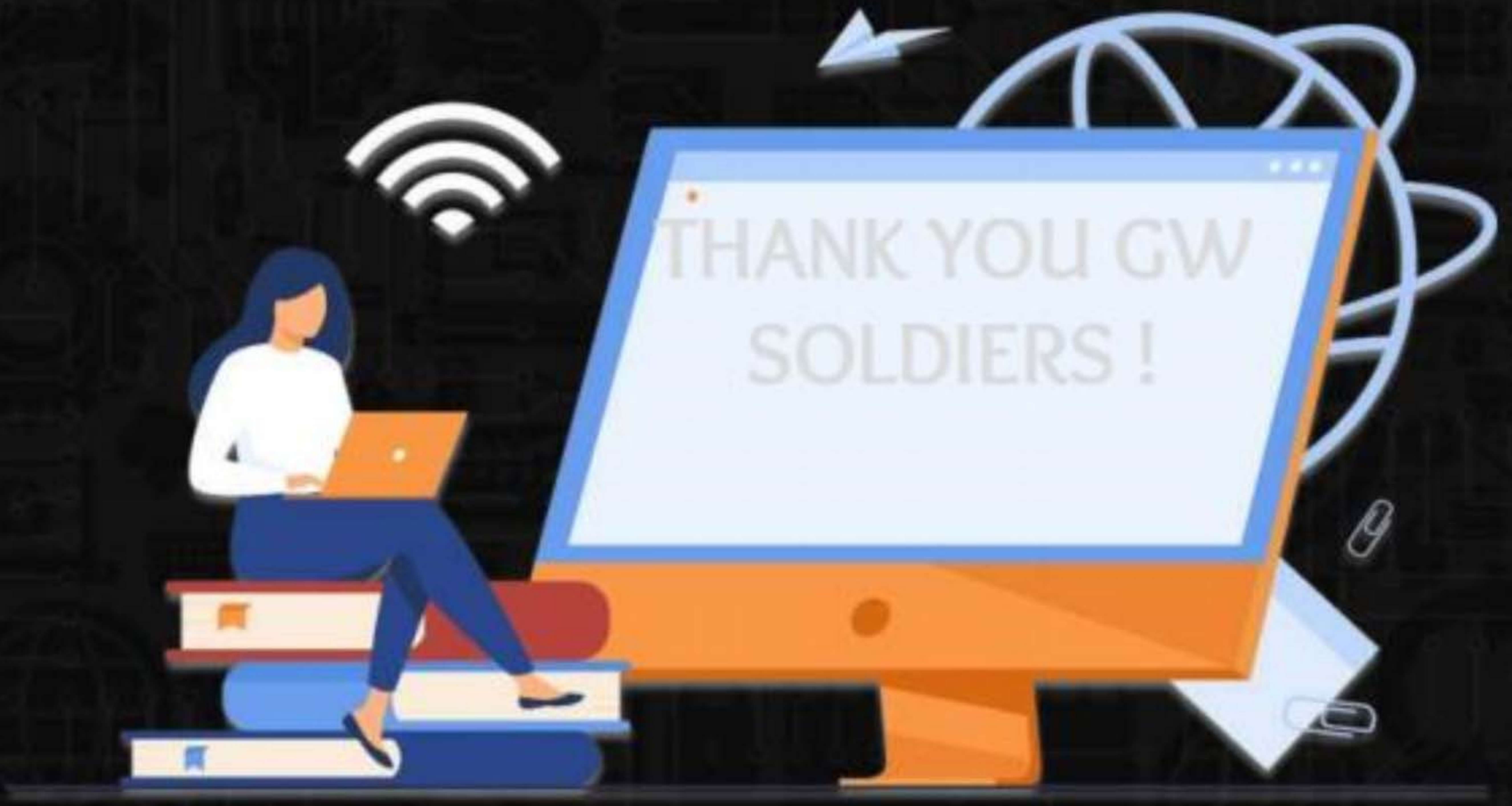
ii) $[(p \vee q) \to r] \Leftrightarrow [(p \to r) \wedge (q \to r)]$

iii) $[p \to (q \vee r)] \Leftrightarrow [\neg r \to (p \to q)]$

a) $p \vee [p \wedge (p \vee q)] \Leftrightarrow p$

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

c) $[(\neg p \vee \neg q) \to (p \wedge q \wedge r)] \Leftrightarrow p \wedge q$


THANK YOU GW
SOLDIERS !