



CS & IT ENGINEERING

Mathematical Logic

DPP 01
Discussion Notes

[MCQ]

1. Which of the following is tautology?

$$(a) \quad (\overline{\neg p \wedge (\overline{p \rightarrow q})}) \rightarrow \neg q$$

$$\begin{array}{l} q = T \\ \neg p = F \quad p = F \end{array}$$

$$(b) \quad \neg(p \rightarrow q) \rightarrow \neg q \quad (\neg)$$

$$(c) \quad [(\neg p \wedge q) \wedge \overline{q \rightarrow (p \rightarrow q)}] \rightarrow \neg r$$

$$(d) \quad \text{None of these} \quad \overline{\neg r \rightarrow (\neg p \rightarrow \neg q)}$$

$$r = T$$

$$\neg p = T \quad p = F$$

$$q = T$$

$$\frac{\neg r \rightarrow (\neg p \rightarrow \neg q)}{\neg r}$$

$$\frac{\neg(\neg p \rightarrow \neg q)}{\neg(\neg p \rightarrow \neg q)} \rightarrow \neg q$$

$$\neg(\neg p \rightarrow \neg q)$$

$$\neg(T)$$

$$F \rightarrow$$

$$q = T$$

$$\frac{\begin{array}{c} \rightarrow T \\ \neg \text{true.} \\ F \rightarrow \\ \neg \text{true} \end{array}}{} \quad$$

[MCQ]

2. The statement $[P \vee (P \leftrightarrow Q) \vee Q]$ is equivalent to

- (a) P
- (b) Q
- (c) A tautology ✓
- (d) $(P \wedge Q)$

$$\begin{array}{c} P \vee (P \leftrightarrow Q) \vee Q \\ \text{---} \\ \begin{array}{cc|c} P & Q & \text{---} \\ \hline \swarrow & \rightarrow & \\ T & T & \\ \rightarrow & T & F \\ & F & T \\ \searrow & \rightarrow & \\ F & F & F \end{array} \end{array}$$

$P \vee (P \leftrightarrow Q) \vee Q$

Truth table:

| P | Q | $P \vee (P \leftrightarrow Q) \vee Q$ |
|---|---|---------------------------------------|
| T | T | T |
| T | F | T |
| F | T | T |
| F | F | F |

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3. Consider the following statement

$$S_1: \quad [(\mathbf{p} \Rightarrow \mathbf{q}) \wedge (\mathbf{q} \Rightarrow \mathbf{r})] \Rightarrow (\mathbf{r} \Rightarrow \mathbf{p})$$

$$S_2: (((p \Rightarrow q) \wedge (q \Rightarrow r)) \Rightarrow (p \Rightarrow r))$$

Which of the following is/are correct?

- (a) S_1 is contingency ✓
 - (b) S_2 is tautology ✓
 - (c) S_1 and S_2 both contingency
 - (d) S_1 and S_2 both Tautology

$$\frac{\frac{\frac{\top}{(P \rightarrow Q) \wedge (Q \rightarrow R)} \rightarrow (\neg P \rightarrow \neg Q) \wedge (\neg Q \rightarrow \neg R)}{(\neg \neg P \rightarrow \neg \neg Q) \wedge (\neg \neg Q \rightarrow \neg \neg R)}}{\neg \neg P \rightarrow \neg \neg R}$$

$$\frac{\frac{\frac{\neg T}{(P \rightarrow q) \wedge (q \rightarrow R)}}{T} \quad \text{false}}{(P \rightarrow q) \wedge (q \rightarrow R) \rightarrow (P \rightarrow R)}$$

[MCQ]

4. Which of the following is valid?

$$S_1: p \Rightarrow (q \vee r) \equiv (p \Rightarrow q) \vee (p \Rightarrow r)$$

$$S_2: p \Rightarrow (q \wedge r) \equiv (p \Rightarrow q) \wedge (p \Rightarrow r)$$

(a) S_1 is valid and S_2 is not valid(b) S_1 is not valid and S_2 is valid(c) Both S_1 and S_2 are valid(d) Neither S_1 nor S_2 is valid

$$(p \rightarrow q) \vee (p \rightarrow r)$$

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

$$\underline{\neg p \vee (q \vee r)}$$

$$p \rightarrow (q \vee r)$$

[MCQ]

5. Which of the following is not a tautology?

- (a) $((p \rightarrow q) \rightarrow r) \rightarrow (p \rightarrow (q \rightarrow r))$ ✓
 - (b) $((p \rightarrow (r \vee q)) \rightarrow ((p \rightarrow r) \vee (p \rightarrow q)))$ ✓
 - (c) $(p \rightarrow (r \wedge q)) \rightarrow ((p \rightarrow r) \vee (p \rightarrow q))$
 - (d) $\frac{(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow r)}{(f \rightarrow (\rightarrow f))} \quad r = f$
- $\frac{(p \rightarrow (q \rightarrow r)) \rightarrow ((p \rightarrow q) \rightarrow r)}{(f \rightarrow (\rightarrow f))} \quad r = f$

$$\begin{array}{l} p = f \\ r = f \end{array}$$

| p | q | r | |
|-----|-----|-----|-----|
| f | t | t | f |
| t | f | t | f |
| t | t | f | f |

