

EE1001 Fundamentals of Digital Techniques

Assignment 3 (Solution)

Marking Policy:

- 25 marks for Q.4 and 12.5 marks for each of the other questions.
- Q.2 and Q.3 will not be marked. Full marks will be given for students who have provided answers to the questions.

1. Inference steps:

- 1) $p \vee q$
- 2) $\sim p$
- 3) q (DS 1, 2)

Conclusion: The universe has a supernatural cause.

2. Inference steps:

- 1) $p \wedge q$
- 2) $r \rightarrow \sim s$
- 3) $\sim s \rightarrow \sim q$
- 4) $r \rightarrow \sim q$ (HS 2, 3)
- 5) q (S 1)
- 6) $\sim r$ (MT 4,5) Note: q is logically equivalent to $\sim\sim q$.

3. Inference steps:

- 1) $\sim p \vee q \rightarrow r$
- 2) $s \vee \sim q$
- 3) $\sim t$
- 4) $p \rightarrow t$
- 5) $\sim p \wedge r \rightarrow \sim s$
- 6) $\sim p$ (MT 3, 4)
- 7) $\sim p \vee q$ (G)
- 8) r (MP 1, 7)
- 9) $\sim p \wedge r$ (C 6, 8)
- 10) $\sim s$ (MP 5)
- 11) $\sim q$ (DS 2, 10)

4.

a) Some possible answers:

“Not all men are created equal.”

“Some men are created unequal.”

b) Some possible answers:

“Some of us are not in the gutter or none of us are looking at the stars.”

“Some of us are not in the gutter or all of us are not looking at the stars.”

5. The negation is $\exists x \in \mathbf{R}, x > 3$ and $x^2 \leq 9$.

6. Yes, it is true because you can always find $y = \frac{1}{x}$ such that $xy = 1$.

7. No, they are not.

[In this question, you are not required to provide a reason. To see that it is invalid, consider the case where D is the set of non-zero integers, $P(x)$ means “ x is a positive number”, while $Q(x)$ means “ x is a negative number”. Then

$\forall x \in D, P(x) \vee Q(x)$ is true since for all x in D , x is either positive or negative.

$(\forall x \in D, P(x)) \vee (\forall x \in D, Q(x))$ is false, since it says that “all x in D are positive or all x in D are negative”.]