

DISCRETE MATHEMATICS

Computer Engineering in Management and Information Systems

MID-TERM EXAM

October 30, 2020

EXERCISE 1

Determine by using properties of logical equivalence if the following logical statement is a tautology or a contradiction:

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

(1.5 points)

EXERCISE 2

Simplify the following statement using properties of logical equivalence:

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

(2.25 points)

EXERCISE 3

Verify that the following logical reasoning is valid:

“Gotzon is positive for COVID-19 and if I am a close contact then I will be quarantined. Gotzon is not positive or the PCR is reliable. Gotzon is positive or I will not be quarantined. Therefore, the PCR is reliable and Gotzon is positive or I am not a close contact.”

(1.5 points)

EXERCISE 4

Let $f : \mathbb{R} \rightarrow \mathbb{R}$ and $g : \mathbb{R} \rightarrow \mathbb{R}$ be two correspondences defined as follows:

$$f(x) = \frac{-1}{e^x}$$

$$g(x) = \begin{cases} -(x+1)^2 & x \leq -1 \\ \sqrt{x+1} & x > -1 \end{cases}$$

- Plot the correspondences.
- Determine whether f and g are applications. If so, then analyze their properties.
- Compute $f \circ g$.
- When possible calculate the inverse application.

(2.5 points)

EXERCISE 5

The binary relation below is defined in $A = \{2, 3, 5, 6, 12, 15, 18\}$:

$$xRy \Leftrightarrow \exists c \in \mathbb{Z} \ / \ y = cx$$

- a) Analyze the properties of the binary relation.
- b) Is it an equivalence relation? Is it an order relation? Justify the answers.
- c) What elements are related to element 6? Justify the answer.
- d) Is it possible to draw the Hasse diagram? If so, then plot it. Justify your answer.
- e) If possible, determine the special elements of subset $S = \{6, 12, 18\}$. Justify your answer.

(2.25 points)
